SACRED SITES FOR THE CONSERVATION OF BIODIVERSITY

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To my uncle, Duilio Ferrari,

who first taught me about the existence of Higher Beings

For those who have a religious experience

all nature is capable of revealing itself as cosmic sacrality

Mircea Eliade

CONTENTS

SUMMARY

This work explores the ecology of sacred natural sites in Central Italy, and their potential for biodiversity management and conservation. Sacred natural sites are areas of land or water that hold spiritual significance for specific communities. Also, they have been recognized to play a crucial role for the conservation of habitats and cultures. The study of sacred natural sites is growingly acknowledged as an important contribution to conservation science.

In **Chapter one**, I discuss the significance of sacred natural sites in relation to current trends in conservation biology and the establishment of a community-based conservation paradigm. Further, I review the role of interdisciplinarity in the study of sacred natural sites and conservation issues, with particular emphasis on cultural anthropology. I argue that sacred natural sites are an ideal ground for advancing research in a number of academic fields, whether that is finalized at applied conservation, or at the theoretical understanding of human-environmental relations in general.

In **Chapter two**, I rely on a literature review and first-hand observations to identify patterns and trends characterizing Catholic sacred sites in Central Italy. I show that a high number of sites are located in natural areas or associated with natural features, and that this is more frequently the case for certain strands of Catholicism than for others. Further, these natural sacred sites often display ecological features that confirm an important conservation role. These results suggest that a significant connection between spirituality and nature seems to be more frequent within western Christianity, than commonly thought.

In **Chapter three**, I analyze forest structure and plant diversity at a sample of thirty sacred natural sites, and compare them with an equal number of control sites having similar habitat and environmental traits. I demonstrate that the sacred sites have been key in preserving giant tree specimens and patches of old-growth forest, harbour more plant species and exhibit a more heterogeneous habitat structure than the control sites, and significantly

contribute to β-diversity at the landscape level. I conclude that such patterns are related to structural environmental features at the sites, but also to traditional, low-intensity forms of anthropogenic activity which contribute to preserving site diversity and conservation value.

In **Chapter four**, I rely on the available literature to investigate ethnobotanical values at the same sample of sacred and control sites. I show that there are not significant differences in the number and proportion of useful plants, while the distribution of trees varies significantly, as the largest specimens are clustered in the vicinity of the sacred sites. This suggests that, contrarily to expectations, useful species have not been significantly nurtured at sacred sites. Only trees have been selectively managed and conserved, probably in virtue of the symbolic and spiritual values that they carry. The results also underline the importance that forest ecosystems have played for rural livelihoods in the area: this element of local heritage should be considered in forest conservation and management schemes.

In **Chapter five**, I offer a synthesis of the findings from the previous chapters, discuss the limitations of the study, and outline desirable directions for future research.

CHAPTER ONE

General Introduction

Sacred natural sites are portions of land or water that hold spiritual significance for specific communities (Wild and McLeod 2008). Recent research has shown that ancient sacred sites are often hotspots of cultural, as well as biological diversity (Vershuuren et al. 2010): they can be thought of as “the world’s oldest form of habitat protection” (Dudley et al. 2009). This can offer crucial opportunities for conservation (Bhagwat and Rutte 2006), especially as it is realized that in the face of ongoing biodiversity losses (Stockard 2010), the role of conservation outside of protected areas is destined to become pivotal (Willis et al. 2012). In this thesis, I offer one of the first systematic investigations of sacred natural sites in a western context, namely Central Italy. This introduction gives an overview of the relevance of sacred natural sites for current trends in conservation biology, discusses the relation with cultural anthropology, and outlines avenues for future research. Specific aspects of sacred natural sites ecology and conservation in Central Italy are treated in the following chapters.

Sacred places

The connection between physical places and spirituality is a ubiquitous pattern that has accompanied human kind for time immemorial. It would be hard to name just one human culture in which particular places have not been charged with spiritual meanings or treated as objects of worship. Places can be revered for various reasons: they may have been a location of miracles or other portentous events; they may be related to the birth, death, or life history of a saint; they may be believed to be the “dwelling site” of a deity, or emanate particular powers. Still nowadays, millions of believers worldwide travel great lengths to take their vows and devotions to the sacred places of their faiths: this phenomenon, commonly known as pilgrimage, remains the driver of one the most massive movements of people even in the contemporary world (ARC 2013), and is so pervasive to have been considered a fundamental human archetype (Clift and Clift 2004). The intrinsic relation between spirituality and physical places has inspired the reflections of renowned historian of religions Mircea Eliade, who saw the manifest irruption of the sacred into the worldly space as one of the fundamental traits of every religious experience (Eliade 1959). Human geographers have also dedicated attention to the nexus between space and spirituality: Yi-Fu Tuan in particular underlined the inherent spatiality of the idea of “sacred” (1978), and indicated the sacred and the numinous as essential roots of the pan-human inclination for place-attachment, or “topophilia” (Tuan 1974).

In spite of its universal relevance and timeless appeal, however, a notion of “sacred place” has been largely eschewed in academic reflections and research for several decades – while mushrooming in mainstream culture, in the guise of New Age revelations or

esoteric books of different hues and shades. The lack of explicit involvement of their discipline with the spatial and geographical dimensions of religion has indeed been lamented by theologians (Bergmann 2007, 2009). Similarly, human geographers have repeatedly denounced the disarray and paucity of progresses on questions pertaining to religion and spirituality within their field (Kong 2001; Holloway and Valins 2002). This might have been a more or less direct consequence of the positivistic tendencies and disciplinary compartmentalization that have long dominated academic life, making notions like “sacred” and “place” – let alone their marriage in a single, fuzzy entity – appear overly general and elusive to find proper citizenship among scientific priorities. In this general context, therefore, it can appear surprising that the new wave of scientific interest, which has recently invested sacred places, has originated from one of the fields traditionally most hostile and refractory to religion, that is, applied biology.

Religion, nature, conservation

In truth, a certain degree of flirting between the worlds of biology and religious faith has been underway already for quite some time (Wilson 2006). Conservationists have not overlooked the evidence that more than 88% of the world population adheres to some spiritual doctrine (Encyclopaedia Britannica 2013), and that belief systems are often crucial for steering individual attitudes and norms of conduct, also in relation to the environment (Boyd 1994; Palmer and Finely 2003). Notably, already in 1986, the World Wide Fund for Nature (WWF) initiated an inter-faith dialogue on the environment, which led to official statements by leaders of the world's major faiths on how their teachings could contribute to the cause of conservation (WWF 1986). In that wake, also an organization explicitly working on partnerships between religions and ecologists, the Alliance of Religions and Conservation (ARC), was launched in 1995.

At the academic level, attention to the relation between religion and nature has also been on the rise since the 1990s, when theologians and scholars of religious studies began investigating the place of nature and environmental attitudes across different belief systems (e.g., Gottlieb 1996; Northcott 1996; Taylor 2005; Tucker and Williams 1997; Tucker and Berthrong 1998; Hessel and Radford Ruether 2000; Grim 2001; and Hart 2006). In that wake, some have also come to the suggestion of regarding nature conservation itself as a new form of religion, supplanting old faiths in an increasingly secularized world (Orr 2003; Dunlap 2004).

Contrarily to those relatively rapid developments, renewing the curiosity for place-bound manifestations of the nature-religion interface, and acknowledging the intrinsic potential of sacred spaces for *in situ* conservation, have been slower and later processes. Also in this case, the first roots sink considerably earlier in time: it was 1975 when Indian ecologists Gadgil and Vartak published the pioneering article "Sacred groves of India: a plea for continued conservation", where they highlighted that biodiversity at certain religious sites had been long protected in name of spiritual beliefs, but was becoming growingly threatened by the demise of the traditional faith (Gadgil and Vartak 1975). Nevertheless, only in the last decade has the ecological study of sacred places gained real momentum. It is during the last ten years, that also the expression "sacred natural site" (henceforth abbreviated SNS) has emerged and progressively penetrated the academic jargon, to indicate places where spiritual and biological values are tightly intertwined. More specifically, SNS have been defined by the International Union for the Conservation of Nature (IUCN) as "areas of land or water having special spiritual significance to peoples and communities" (Wild and McLeod 2008).

A number of contributions have led to the recognition of the conservation value of SNS over the last ten years. In 2005, an influential report commissioned by WWF and ARC highlighted the relation between sacred sites and conservation, by identifying no less than one hundred sacred sites around the world that fall within the borders of biodiversity-rich protected areas (Dudley et al. 2005). One year later, based on a systematic search in scientific journals, Bhagwat and Rutte found mention of sacred places related to natural areas in every continent of the planet (except for Antarctica), and suggested that sacred sites might have played an important role in conserving habitat types (such as lowland forest groves) that are often left out of the official network of protected areas (PAs) (Bhagwat and Rutte 2006). In 2003 and 2006, the nexus between sacred places and biodiversity was further highlighted by two workshops organized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Lee and Schaaf 2003; Schaaf and Lee 2006). In 2010, finally, a volume edited by Verschuuren and others offered a comprehensive overview of the available knowledge on SNS from the angles of environment, culture, and management alike (Verschuuren et al. 2010). At the same time, throughout the whole decade, numerous studies with a more specific geographical focus and grounded in ecological methods have documented the important conservation value of SNS around the world, and especially in Africa and East Asia. This body of research has quantitatively proven that SNS tend to harbour high rates of biodiversity, and occasionally provide even more effective conservation than PAs in the same regions (reviewed in Dudley et al. 2010; see Table 1 for a quick overview).

Table 1. Synthetic overview of some of the major findings from ecological research on sacred natural sites

Study	Study system	Findings and conclusions
Byers et al. 2001	Sacred and non-sacred patches of dry forest in the Muzarabani area in northern Zimbabwe	Very marked and significant differences in deforestation rates between sacred (33%-50% forest area lost) and non-sacred (65%-91% forest area lost) patches, recorded between 1960 and 1993
Boraiah et al. 2003	Ten sacred groves and five reserve forests in Kodagu district, Western Ghats, South India	Sacred groves conserved medicinal plants better than state reserves: higher number of medicinal species, ca. 40% of medicinal species unique to sacred groves, double density of regenerating medicinal plants
Mgumia and Oba 2003	Ugunda State Forest Reserve and eight sacred groves nearby in the Igalula region, central Tanzania	Higher tree density and species richness in sacred groves than forest reserve. High number of species unique to sacred groves
Bhagwat et al. 2005	58 sites representing forest reserves, coffee plantations, and sacred groves in Kodagu district, Western Ghats, South India	Endemic trees significantly more frequent in reserves, but threatened trees significantly more frequent in sacred groves. Significantly higher numbers of bird and macrofungal species in sacred groves than official reserves
O'Neal Campbell 2005	Sacred and non-sacred forest patches in a 200 km stretch of savannah along the coast of Ghana	Lower deforestation rates in sacred groves (ca. 86% *vs.* 26% of 1960 cover left in 1996). Significantly larger number of plant species and average tree diameter in sacred groves than non-sacred forests
Anderson et al. 2005; Salick et al. 2007	Comparison of sacred and randomly selected non-sacred sites in the Menri region, southeastern Tibet	Significantly higher number of medicinal and endemic species, and higher overall species richness in the sacred sites (Anderson et al. 2005). Significantly greater tree total cover and tree size in sacred areas (Salick et al. 2007)
Wassie et al. 2010	28 Church forests in the South Gondar Administrative Zone, Ethiopia	Important for conserving woody plats in a highly eroded area, where forests account for <2% of total land cover. Higher number of woody species was found than in the largest continuous forest of Ethiopian highlands, and high species richness found independently of small patch sizes
Bossart and Antwi 2013	Two forest reserves and five sacred grove fragments in Ghana	Sacred groves retained higher or comparable levels of genetic diversity of three forest butterfly species to those found in forest reserves, despite being only 1-10% of the area of the reserves

Sacred Natural Sites and the new paradigm of conservation biology

This rapid rise of interest has certainly been fed by a number of success stories, which have convincingly shown the merits of SNS as loci of both spirituality and conservation. Yet, it is also a symptomatic result of broader and more profound changes which have been underway in applied conservation biology, leading to the affirmation of people-oriented, inclusive conservation models, in face of the exclusory, "fortress conservation" visions of the past (Murphree 2002). In that perspective, Berkes identified three interrelated major trends in ecology, which have been pivotal for the emergence of this new conservation paradigm (2004): (a) the shift from a reductionist to a systemic view of the world; (b) the conceptual integration of humans as part of the ecosystem; and (c) the displacement of top-down, expert approaches to biodiversity management. In the following review, I will briefly elaborate on points (b) and (c), as they can help to effectively illustrate some of the fundamental characters of SNS, and how they are relevant to current trends in conservation.

Humans as part of ecosystems, biocultural linkages, and Sacred Natural Sites

Since inception, the discipline of ecology has been predominantly driven by an ideal image of pristine nature, and attempted to take its research to (apparently) untouched landscapes where that notion could be pursued. The search for laws in nature, *as if people did not exist*, has always represented a determining *leitmotif* in the field. Human activity has commonly been seen as mere "noise", if not as a plain and actual disturbance and disruption of a supposed state of climatic balance and "naturalness" of nature (Parrotta and Agnoletti 2007). The positivistic conception that removes the knowing subject from the world of observed objects (Morin 1993) seems clearly mirrored in such an attitude. Yet, in the domain of ecology, it has led to especially paradoxical and philosophically slippery conclusions, postulating the existence of a definitive fracture – but on what theoretical grounds remains nebulous – between humanity and the rest of the biosphere. On the one hand, there is all of life on earth; on the other, humans, seen in turn as “managers”, “stressors” or, in case of positive science, external and supposedly impartial “observers” of the natural world.

Consensus has been rising that both the field of ecology and the cause of conservation at large would have much to gain by moving beyond this theoretical *impasse*. The concept of *social-ecological systems*, for example, was introduced as a way to ecologically think of humans as part of the ecosystem (Berkes and Folke 1998), but already in earlier years, a holistic view of landscapes as tangible expressions of the *total human ecosystem* emerging from the encounter of nature and human mind (Naveh 1995), had breached and made way into the field of landscape ecology (Naveh and Lieberman 1984). Nearly twenty years have passed, and in the face of noticeable but still too feeble advancements, the urge to better integrate the intertwining of human activity and ecosystems has become even more pressing, as human influence on the planet is continuously growing (Pressey et al. 2007; Ellis et al. 2010), and leading to the formation of species assemblages and biodiversity patterns that were unknown just a few decades ago (Hobbs et al. 2006).

While images of pristine nature and ecosystems left untouched by humans – we could say “wild” – are the tenets that have informed a lot of our ideas about the environment (Cronon 2005) and orthodox ecological theory (Gomez-Pompa and Kaus 1992), awareness is increasing that the relation between humans and biodiversity is somewhat more nuanced than assumed on the grounds of a plain nature-culture antithesis. The hypothesis, commonly known as “intermediate disturbance”, that species diversity locally benefits from moderate rates of disturbance and non-equilibrium conditions has a relatively long history in ecological theory (Grime 1973; Connell 1978; Huston 1979), and is finding continuous support (Mayor et al. 2012). The disturbances in question can be abiotic (e.g., storms, drought), but also anthropogenic, such as grazing and controlled fires (Naveh and Whittaker 1980). Recent research has additionally confirmed that, rather than being necessarily detrimental to biodiversity, certain human practices can actually be crucial for promoting and maintaining the diversity of specific systems. For example, it has been demonstrated that species-rich grasslands in Sweden and Switzerland are related to low-intensity farming regimes and differentiation of land-uses, with human abandonment leading to substantial decreases in diversity rates (Gustavsson et al. 2007; Maurer et al. 2006). Similarly, traditional activities such as selective thinning or the collection of understory products can favor the diversification of micro habitats (Duelli 1997; Pausas and Austin 2001), and therefore bring about significant increases in overall species richness, as found in *Quercus suber* forests in Tuscany (Selvi and Valleri 2012).

Studies of this kind have greatly contributed to casting a different light on the range of human-environmental relations, and to revealing the tight ecological interplay that unites human cultures and ecosystems. The importance of this linkage has become increasingly accepted also in important policy statements. After careful consideration, for example, UNESCO deliberated in 1992 to adopt the concept of “cultural landscape”, to indicate heritage sites that are representative of outstanding histories of interaction and co-evolution between humans and environment (Mitchell et al. 2009). In a similar way, from a conservationist standpoint, awareness has grown that the preservation of ecologically valuable landscapes often depends on the ongoing survival of underlying cultural practices (Parrotta and Agnoletti 2007) which, however, are themselves threatened of extinction by social homogenization and the tyranny of economic efficiency. The notion of “biocultural diversity” has been introduced and widely embraced over the last fifteen years, to specifically denote this intricate relationship between human cultures and ecological systems (WWF 2000; Posey 1999; Loh and Harmon 2005; Maffi 2005), and bring attention to the fact that variety in cultural practices and traditions is often associated with high rates of biological diversity (Cocks 2006).

SNS represent a clear exemplification of similar views on biocultural diversity and "humans as part of ecosystems". Bhagwat et al. (2011), for example, found a strong association between religious plurality and high biodiversity rates in so-called "hotspot countries" (Myers et al. 2000). Others have stressed the explicit role of SNS as hotspots of biocultural diversity (Verschuuren et al. 2010; Pungetti et al. 2012), given their contribution to the conservation both of biological values (as reviewed above) and traditional cultural customs (e.g., Lebbie and Guries 1995; Chouin 2002; Swamy et al. 2003; Fomin 2008). The inextricable linkage between cultural practices and biodiversity can concretely be seen in some of the floristic patterns often encountered at SNS, such as the high incidence of medicinal plants or other useful species (Salick et al. 1999; Boraiah et al. 2003; Khumbongmyum et al. 2005; Mesfin et al. 2009). These suggest that the sites in question do not necessarily represent patches of untouched nature, although that might occasionally be the case, but are the outcome of active management regimes that result beneficial rather than detrimental to local diversity (Sheridan and Nyamweru 2008; Sheridan 2009).

Displacement of expert management, local perspectives, and Sacred Natural Sites

As mentioned above, the progressive decline of centralized, expert-driven approaches to biodiversity management has been one of the most prominent trends in conservation biology over the last twenty years. Berkes puts this in direct relation to information- and risk-sharing between local people and management agencies, a step which is deemed fundamental for the solution of problems that often defy the assumptions of linear predictability and control of conventional science, and require place-contingent models and approaches (2004). Involvement of indigenous communities and local stakeholders has become increasingly more frequent in applied conservation, and although it should not be considered an infallible recipe, it has occasionally led to undeniable successes (e.g., Agrawal 2005; Borrini-Feyerabend et al. 2007). A revaluation of local forms of knowing, alternative or complementary to science-based ones, has been an integral component of this process (Berkes 2004). Traditional ecological knowledge (TEK) has been defined as "a cumulative body of knowledge […] evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes et al. 2000). It is partly comparable to western scientific approaches, in the sense that both hinge on the accumulation of observations and repeated trials-and-errors, and has been soliciting a true surge of interest for its documented contributions to the sustainable resource use made by many indigenous communities (Berkes 1999).

If TEK has become a key idea in the new conservation arena, and environmental projects are increasingly aiming at a dynamic and participatory integration of TEK (Berkes 2004), that of "values" is another broad concept that has drawn great attention, in the attempt to transcend and improve the schemes of the past (Harmon and Putney 2003; Verschuuren 2006). Unfortunately, "value" is no less fuzzy, easier to define, or consensual a notion than "place" or even "sacred" (Graeber 2001). Further, in recent decades it has literary been a battleground, crisscrossed by contrasting tendencies. On the one hand, environmental philosophers have worked on establishing an essentialist and a-historical definition of value, which would bestow intrinsic worth on every being of the creation, regardless of the questions: "of value for what, and to whom?" (Callicott 1984). On the other, economists themselves have tried to overcome essentialist interpretations uniquely based on monetary considerations or notions of utility, and move towards pragmatist and relational definitions (Klamer 2003). And a pragmatist angle seems especially appropriate for the present discussion. A fundamental realization, in fact, has been that conservation schemes have long been driven by ecological tenets and sets of values that make perfect sense in the context of Western science, but are exogenous and difficult to translate to the settings in which they are likely to be applied. *Biodiversity* itself can be seen as a discursive construct largely produced and enacted by institutional actors (research centers, NGOs, private companies, etc.) of the Western world (Escobar 1998), although its ultimate recipients often are communities located in the Southern hemisphere. Yet, local understandings, meanings, and values of biodiversity and nature can be radically different from Western dominant ones, and consensus is being established that those should be equally taken into consideration, for conservation to be ethically fair (Brown 2003).

By definition, conservation schemes around the world should be instrumental in preserving biodiversity and promoting sound ecological management, defined in Western scientific terms. Ecological values, however, are but one side of all the values that conservation projects are currently expected to deliver. It might not be liked, for example, but attention to the plainly economic value of conservation has irrupted into the agenda already since some time, and generation of wealth and development have come to be seen as inevitable requisites for the local acceptance of conservation projects and their fairness, as the proliferation of a rich, sometimes critical literature in regards testifies (e.g., Christie et al. 2012; Sandker et al. 2012; Carriere et al. 2013). Further, ecological values themselves can have also a local declination: indigenous people might hold notions that are not so dissimilar from "sustainability" or "ecosystem health", although embedded in their form of TEK and not based on scientific understandings and quantitative methods (Gadgil et al. 1993). Conservation can have a lot to gain, when the definition of these values can overlap: attention to local cultural contexts has been found to even be most important factor in determining the successes of conservation interventions (Waylen et al. 2010).

SNS and faith-based conservation appear extremely consistent with these broader trends, as they represent quintessential instances of conservation that is both successful – even by the standards of western ecological science – and based on "emic" understandings[1].

[1] The distinction between "emic" and "etic" has a long and rich history in cultural anthropology. In short, "emic" indicates the world, as it is perceived, explained, and understood by indigenous people: it refers to the local perspective. "Etic", instead, refers to the categories and interpretations laid upon local contexts from outside, and therefore refers to the external observer's perspective (Goodenough 1970; Harris 1976).

In this sense, an anecdote reported by Ormsby and Bhagwat (2010) neatly encapsulates the idea: “in Udaipur district (Rajasthan, north-west India), the sprinkling of saffron water around a piece of land is a common practice […]. The attempts of the local forest department to conserve an area of forest at a site near Udaipur were largely unsuccessful because of persistent transgressions by local people. Frustrated, the forest officers decided to sprinkle saffronwater around the site, in accordance with the local tradition. This was greeted with enthusiasm by the local people and, since then, they have respected the boundaries of the conservation area”. Social customs, taboos, and traditions are indeed indicated as the cornerstones upon which indigenous systems of resource management are based (Colding and Folke 2001; Tengö et al. 2007; Jones et al. 2008; and also Harris 1971, 1979; and Rappaport 1968). They are also responsible for passing down the generations the norms that regulate the sound use of environmental resources (Berkes 2000), and as such they have perpetuated the sets of bans and prohibitions which have favored the conservation of SNS.

If this set of more or less formal institutions (North 1990; Colding and Folke 2001) constitutes one pillar of conservation at SNS, intangible values of biodiversity can be indicated as a second crucial driver. That of intangible values, is a slippery concept to circumscribe. It has, however, elicited widespread interest over the last twenty years, including from international organizations such as UNESCO. In its *Convention for the Safeguarding of the Intangible Cultural Heritage*, UNESCO offers some guideline, defining intangible cultural heritage as “the practices, representations, expressions, as well as the knowledge and skills […] that communities, groups and, in some cases, individuals recognise as part of their cultural heritage. It is […] manifested inter alia in the following domains: oral traditions and expressions, including language […]; performing arts; social practices, rituals and festive events; knowledge and practices concerning nature and the universe; traditional craftsmanship” (UNESCO 2003).

It is increasingly recognized that intangible values have always played a fundamental role in the relationship between humans and the environment. Environmental psychologist Stephen Kellert, for example, indicates nine basic values of (or attitudes towards) nature, at least five of which hinge on the appreciation of the intangible benefits that nature and biodiversity can deliver (Kellert 1996). Such benefits include: aesthetic enjoyment; inspiration for art, thought, language, and other symbolic processes; spiritual fulfillment; and sense of belonging and attachment. Furthermore, similar intangible values have been at the source of modern ideas about nature conservation. To a great extent, the conceptual roots of Western conservation can be found in ideas of aesthetic, moral, emotional, and spiritual appreciation of nature, disseminated in the writings of early conservationists like Thoreau (1971), Muir (1997), Aldo Leopold (1987), and even earlier in the views of German Romanticism and late Kantian philosophy (Cronon 1995).

In spite of this historical prominence, consideration of intangible values of nature has heavily lost ground in current conservation visions. This is largely due to the difficulties of translating intangible values into objectifiable and measurable benefits, in accordance to the tenets of cost-benefit analysis and the utilitarian views that tend to inform current approaches to conservation (McCauley 2006). This notwithstanding, the fact remains that non-utilitarian but deeply rooted values have never ceased to act as fundamental drivers of conservation (Jepson and Canney 2003), and their importance is getting progressively acknowledged also in ecological economic frameworks. The Millennium Ecosystem Assessment, for example, lists a series of “cultural services” that are provided by ecosystems around the world (MEA 2005), while de Groot et al. (2002) define a comparable set of values as “information services”.

In this perspective, SNS appear of great relevance to current debates, as they confirm the prominence of the intangible both as a source of value in nature, and as a primary driver of conservation. Conservation of SNS, in fact, has largely relied on the enduring vitality of such values among local communities, and their ability to withstand cultural and social stress, or supersede impending utilitarian considerations (Byers et al. 2001; Verschuuren 2006). Besides being coherent with an integrated view of socio-ecological systems, therefore, SNS seem to particularly fit rising paradigms of biological conservation for at least two additional reasons: (1) they confirm the effectiveness and resilience of local drivers and forms of knowledge in bringing about effective conservation; and, in doing so, (2) they offer a somewhat more democratic view of conservation practice, being grounded on emic understandings and valuations, rather than on the top-down imposition of an exogenous set of values.

Interdisciplinary conservation science: lessons from cultural anthropology (from the past and for the future)

With this review, I hope to have demonstrated the substantial consistency between research on sacred places and some major trends in biodiversity conservation. Rather than being an extravagant and transient curiosity, I argue, interest in SNS has been so significantly on the rise because they epitomize some of the main turns taken by conservation over the last two decades. It might be asked at this point, however, what in the first place triggered such radical developments in biological conservation as the ones outlined above. Providing a comprehensive answer would probably be a complicated and multilayered process, extending beyond the scope of the present discussion. A partial explanation, nonetheless, can be temporarily attempted here.

After outlining some of the challenges that lie ahead for the emerging community-based conservation paradigms, Berkes concludes that one of the inevitable developments will be tighter integration between research fields, leading to the establishment of a truly interdisciplinary conservation practice (2004). While this should certainly be the case, and greater integration between disciplines is something that we can all hope for, I believe that the first fruits of interdisciplinarity have already been reaped. The very emergence of a community-based conservation paradigm rises from the encounter of ecology and biology with other traditions and ways of thinking about environmental issues. And it is my conviction, in this context, that cultural anthropology has played a truly pivotal role.

Ecology and the environment have been important topics in cultural anthropology since the outset, although their development within the discipline has been far from harmonious, and proceeded by contrasting waves (Orlove 1980). After a hiatus of around a decade, finally, a new swell of environmental anthropology began consolidating in the late 1980s, in the wake of mainstream concerns for global warming and ongoing mass extinctions (Descola and Pálsson 1996). Out of the numerous contributions that have been accumulated since then, three broad insights seem to have proven especially influential.

Firstly, anthropologists and ethnographers have been long involved with documenting local uses and values of biodiversity, and the knowledge and practices that indigenous people associate to biological resources (e.g., Nabhan 1985; Redford and Padoch 1992; Brush and Stabinsky 1996). Eventually, this clearly contributed to the mainstream revaluation of TEK, which was discussed above. In a similar way, cultural anthropology has been instrumental in triggering radical developments with regards to applied conservation. Indeed, as advocates for indigenous rights, anthropologists have *de facto* spearheaded the re-thinking of conservation in terms of local involvement and inclusion of emic perspectives (e.g., Wells et al. 1992; Western et al. 1994). As Orlove and Brush remark (1996), such arguments have often been backed by considerations of ethical fairness, social as well as environmental justice, and self-determination (e.g., Gomez-Pompa and Kaus 1992; Turner 1995), quite consistently with the moral and normative tendencies of the discipline (D'Andrade 1995). The pragmatic consideration that conservation schemes are unlikely to succeed without local consent, however, has also been advanced as an important evidence (e.g., Gibson and Marks 1995; Agrawal 2005). At a more conceptual level, finally, anthropological thinkers have been among the sharpest and most vocal critics of the Cartesian dichotomization between subject and object, culture and nature (Latour 1993). A fundamental catalysts in that sense has been the ethnographic insight that a clear demarcation between culture and nature, rather than being a universal, has no meaning or clear translation in the cosmology of many indigenous populations (Descola and Pálsson 1996). Although essentially theoretical, such a development has given new momentum to the elaboration of monistic frameworks for conceptualizing human-environmental relations (Ingold 2000), which have been echoed also in ecosystem management and ecological theory (Berkes and Folke 1998; Berkes 2004).

Anthropology, in sum, has played a primary role in advancing the theory and praxis of conservation, as well as our broader thinking about the relationship between people and environment. At the same time, the critical perspectives of anthropological theory can be of help in warning against excessively easy enthusiasms for community-based conservation, SNS, or any other newest trend that has the declared pretense to deliver win-win solutions to entangled problems. There is no magic bullet in conservation. Community-based approaches are known to succeed as much as to fail (Murphree 2009). The real matter is not whether they are the ultimate panacea to conservation, which clearly are not, but rather to understand *why* they succeed in some contexts, and fail in others (Berkes 2007). The same should be said of SNS. Current narratives about SNS are characterized by a high degree of optimism: they portray a reality where successful conservation is not just planned bottom-up, but even springs from fully voluntary behaviors; or where the human imprint on nature, rather than detrimental, is even beneficial and inscribed in a symbiotic relationship (Negi 2010). Beyond the undeniable appeal of similar constructs, however, it is important to be ready to recognize the possible flaws and shortcomings. While we wait for more empirical evidence, telling us of the inevitable successes and failures of faith-based approaches to conservation, cultural anthropology can suggest at least two basic but crucial caveats.

In the first place, we should be warned against idealized views that once again unidimensionally portray indigenous populations as "ecological noble savages". Just for being indigenous and traditional, an ecological knowledge is not necessarily sound or infallible. It is true that examples abound of local populations that have been able to live in harmony with the environment and use their resources sustainably, based on their TEK and customary wisdom. But human history is also riddled with examples of extraordinary management failures that resulted in species extinctions, resource depletion, and even civilization crashes (e.g., Steadman 1995; Diamond 2005). As for community-based conservation, the point is not that TEK offers an infallible, serve-all key to complex environmental problems: what is important is to understand in what contexts TEK has actually proven successful, and whether and to what extent those insights can be exported to other settings. Another related pitfall is to regard indigenous people and their traditional knowledge as intrinsically separated from "us" and our scientific understanding (Agrawal 1995). This would offer yet another rendition of the dualism between "the West" and "the Rest", culture and nature, reifying the difference between a cultured West, and indigenous populations that understand the world of nature because they have never abandoned it.

The second caveat that comes from the fields of anthropology and its younger sibling, political ecology, regards power relations. It has been mentioned that SNS represent an instance of a democratic way to conservation (Bhagwat and Rutte 2006), as they rely on local meanings, understandings, and participation, and minimize the imposition of values and priorities from external agencies. Even assuming that this is the actual case, and that "participation" is not merely another ideological cloak to perpetuate and conceal uneven power relations between western and international agencies, "developing" countries, and local communities (Escobar 1995; Cooke and Kothari 2001), power relations can represent an open issue also at the local scale. Indeed it is difficult to overlook the fact that religion is not necessarily a politically neutral force. Being largely consensual does not erase the fact that the production of religious truths is inherently situated in a network of power relationships (Asad 1983). It might not be the duty of conservation to meddle with indigenous politics and power balances, and minimizing the introduction of exogenous judgments perhaps is the most democratic and ethically tenable position. Yet, the danger remains of unholy alliances which, however unawarely, offer external recognition and support to oppressive social structures. At least, the democratic nature of SNS and faith-based conservation should not be universalized and taken for granted, but rather assessed case by case and at different scales.

The way ahead: prospects for Sacred Natural Sites research

Given the due caveats, SNS can offer important opportunities for applied conservation as well as theoretically oriented research. The potential advantages of sacred sites and faith-based conservation have already been listed. Future research work in that direction should aim at: (1) gaining insight into the conservation value of SNS in a wider range of geographical contexts; (2) assessing how sacred sites can be most effectively integrated into existing conservation networks, without straining their primary function as spiritual centers; and (3) gaining a better understanding of how cultural practices and biodiversity at SNS are interlinked.

Thus far, ecological investigations of SNS have been narrow in geographical range, having mainly focused on Asia (India, China, Borneo) and Africa. Enlarging this scope certainly represents a first priority. Similarly, SNS have been found to significantly contribute to landscape-scale diversity and connectivity in agro-forestry matrices (Bhagwat et al. 2005). Specific studies, however, are still lacking on how these traits could be integrated to best complement and enhance existing conservation networks. Straightforward inclusion of SNS into official PAs could be desirable in some cases, for example whenever the legal status of nature reserve could protect sacred sites from imminent threats. On the grounds of existing knowledge, however, some caution would seem generally advisable. In the first place, because SNS are primarily religious places and not conservation areas, and their original function and value should be taken in full consideration (Rutte 2011). Secondly, inclusion in PAs can bring unwanted negative effects, such as a greater exposition to mass tourism, with a consequent erosion of ecological and spiritual values (Mallarach and Papayannis 2010). Finally, the ecological qualities of SNS often are a byproduct of specific cultural practices, meaning that biological and cultural conservation are tightly interwoven (Schmitz et al. 2012). In this sense, it would rather be key to establish case by case on what practices the biodiversity patterns found at SNS rely on, and how those relate to the broader cultural and spiritual context. Ultimately, rather than on a cataloguing of TEK that remains static and disembodied (Agrawal 1995), enduring biological conservation at SNS goes hand in hand with the possibility to vitally maintain *in situ* those cultural traits in face of societal change and modernizing pressures, or at least to revitalize them in meaningful forms (Higgs 2005). Inclusion of SNS into official PAs can be beneficial if similar goals are put at the center of conservation plans, while it could prove even detrimental, were it translated into a mere bureaucratization and homogenization of management practices.

Beyond ecology

From an academic perspective, SNS are a unique combination of place, spirituality, environmental features, historicity, and social institutions. As such, besides ongoing work in ecology and applied conservation, they are an ideal ground for research in a number of other fields, and for advancing transdiciplinary approaches. Comparative and in-depth studies of SNS offer the opportunity to address foundational questions concerning sense of place (Tuan 1974; Sheldrake 2001), place attachment (Altman and Low 1992), geography of religion (Park 1994; Stoddard and Morinis 1997), ecotheology and environmental ethics (Gottlieb 1996; Taylor 2010), environmental history (Kiser 2003), historical ecology (Bhagwat et al. 2012), and probably many others. Although it is clear that similar questions would largely be curiosity-driven, they are especially pertinent in a time when the irreversible decline of modernist narratives and politics is forcing us to drastically rethink the relation between humans and environment, and redraw the articulations of our cosmologies (Latour 2009). While a more extensive review of all of those research avenues is beyond the scope of this work, I will further elaborate on three specific themes, which have already been partially developed with promising results.

Sacred sites as common-pool goods

An important area of future research has already been outlined with regards to the social and institutional arrangements that have enabled sound management of SNS. Over the last two decades, there has been a substantial rise of interest for so-called common-pool resources, spearheaded by the growing discipline of institutional economics (North 1990). Common-pool goods are defined on the grounds of two characteristics: (1) their consumption is rivalrous, i.e., consumption by one individual entails subtractions from other individuals; and (2) it is difficult to exclude other potential users from consumption (Samuelson 1954). Common-pool goods have received a negative treatment in classic economics as they solicit free-riding and over-harvesting, leading to what has been defined as “the tragedy of the commons” (Hardin 1968). Two basic solutions are usually indicated to those shortcomings: private ownership or government ownership. A number of empirical studies, however, have demonstrated that overuse of common-pool resources can be successfully prevented also through different forms of governance, based on local institutional arrangements (reviewed in Agrawal 2003; and Rutte 2011). These have been findings of great relevance, because a wide array of natural resources (e.g., fisheries, water, pastures, forests) are common-pool, and they demonstrate that alternative policy responses to mere privatization and nationalization can be pursued.

Based on a systematic analysis of existing literature, it has been shown that many, if not most SNS closely resemble common-pool resources (Rutte 2011). Indeed SNS commonly display one or more of the “design principles” (Ostrom 1990) that also characterize the governance efficacy of common-pool resources. Typical design principles that are frequently found also in SNS are: clear social as well as physical boundaries; mechanisms for monitoring, conflict resolution, and sanctioning; and some formal recognition of the rights of local users over their resources. As SNS often represent successful and long-enduring instances of community-based resource governance, they provide an opportunity to investigate the varying effectiveness of traditional forms of management in maintaining common-pool resources (Rutte 2011). In this perspective, for example, it would be desirable to compare SNS in similar cultural and environmental contexts, and assess how the conservation of environmental resources, spiritual significance, and social cohesion has been affected by different institutional arrangements (Byers et al. 2001). Resilience and adaptability to modernizing pressures and social change are also important elements of inquiry, given the frequency of those criticalities (Chandrakanth et al. 2004; O’Neal Campbell 2004).

The role of ritual and evolutionary theories of religion

Another prominent question related to the issue of resource management and conservation at SNS, regards the specific role played by spiritual beliefs and religious practices. Indeed, while other design principles are shared with secular institutions, the presence of a spiritual dimension characterizes sacred places alone, which makes it a source of particular interest. It can be asked, therefore, whether and to what extent religious beliefs and attitudes reinforce or even substitute other social arrangements that regulate the management of SNS (Rutte 2011). This has clear implications for future conservation of SNS in the face of impending socio-cultural changes, and the governance of common-pool resources in general. The question is even more intriguing as preliminary indications seem contrasting. On the one hand, common-pool resources can be successfully managed also in wholly secular contexts, whereas spiritual importance is no guarantee against breaches and resource degradation (Fomin 2008). On the other, there is empirical evidence that participating in religious rituals fosters greater cooperation among community members (Bulbulia and Sosis 2011), and that cooperation itself is a key element for the success of common-pool resource management (Rustagi et al. 2010).

Investigating the precise role of spiritual beliefs and religious practices in the management of SNS also represents a way to test functional theories of religion and ritual in a context of ecological adaptation. The tenet that among the cardinal functions of religion is promotion of intragroup solidarity, and even maintenance of ecological balances, has a long history in social anthropology (e.g., Radcliffe-Brown 1952; Douglas 1966; Durkheim 1995; Rappaport 1968, 1999). Similar views have also been accepted by evolutionary biologists (Wilson 2002), and experimental testing has confirmed that religiosity enhances social cooperation in communal settings (Sosis and Ruffle 2003). The idea, however, that religious practices might also affect the ecological state of common resources, via the mediation of reinforced social cohesiveness and cooperation, still requires empirical investigation. SNS clearly are the most appropriate context for posing similar questions. A starting hypothesis in that sense could be that ecological integrity, or the state of conservation of specific resources at SNS, is positively correlated with the level of ritual intensity and religious participation encountered at the sites.

Greening of religion and biophilia

A third important direction of research, finally, concerns the cross-cultural prominence of SNS, and the role of mainstream religions in shaping attitudes towards nature and nature-based spiritualities. It has been noted that much of the religion and ecology debate, at least up to the last decade, has been cast in the idealistic (in its philosophical acceptation) terms of the relationship between religious cosmologies, seen as driving forces, and historical agency (Jenkins 2009). Further, this framework has been applied mostly to the grand traditions of world religions, leaving aside more marginal and hybridized forms of spirituality. The very premises that religious ethics are directly responsible for positive environmental attitudes, and that most of the world religions are going through a period of ecological awareness and substantial “greening” (Barnhill and Gottlieb 2001), however, are disputed (Taylor 2011). In an alternative reading, mainly championed by Taylor (2010), the spiritual importance attached to the environment, rather than from the teachings of certain religions, would stem from a pan-human inclination, even biologically determined, to feel empathy and reverence for the world of nature, which resembles the earlier theorizations of “biophilia” (Wilson 1984; Kellert and Wilson 1993). Such a perspective ultimately suggests that the importance of nature in organized faiths is probably an epiphenomenon: reverence for nature is likelier to be found in spontaneous manifestations of spirituality (Taylor 2010), and in mainstream religions we simply witness a reflection (or appropriation) of a more basic human trait.

These are fascinating hypotheses, which can fundamentally influence the way human-environmental relations are thought and conceptualized. Yet, Taylor (2011) also admits that empirical evidence and serious scholarship in regards are tremendously lacking. Among the rest, comparative investigations of SNS can contribute some avenues for partly answering such questions. In the first place, if a spiritual inclination towards nature is a structural human character, those of the universality and cross-cultural distribution of SNS become crucial issues. And while it is not a given that every single culture chooses to express its intimate connection to the environment through forms of worship based on natural places or natural features, confirming that similar spiritual manifestations are ubiquitous would evidently give support to the guiding hypotheses. Secondly, it would be important to assess to what spiritual traditions SNS around the world are associated, and how. It has been noted that folk beliefs and mainstream religions can coexist in local syncretisms, and that the latter have often appropriated the sacred sites of the former ones (Verschuuren et al. 2010). Yet, the terms of this coexistence can be different (from close continuity to manifest conflict), and tell a lot about the relationship between nature and different forms of spirituality. Finally, these place-based relationships should be historicized, and analyzed in a diachronic perspective. Only this step, indeed, could enable to assess what the consolidation of different beliefs and traditions has specifically contributed (or subtracted) in terms of environmental attitudes at SNS (see also Taylor 2011).

Concept and structure of the present work

This thesis aims to advance our understanding of SNS and the relation between humans and environment, by offering insight into some of the themes just outlined. Given the multiplicity and complexity of those questions, my approach has been to focus on a few well-defined issues. In particular, the entire study was driven by one basic, fundamental question:

Do SNS, as they have been introduced and characterized in the previous pages, exist *in the industrialized, non-traditional contexts of western European countries?*

This geographical focus constitutes the main novelty of this study. Up to date, SNS have been mostly investigated in traditional settings outside of Europe (as illustrated earlier). Research efforts on SNS in industrialized countries, promoted by the Delos Initiative, have been substantial over the last years (reviewed in Mallarach and Papyannis 2010), but those precious contributions have been uniquely based on qualitative case studies, and focused on SNS exclusively located within PAs. This has left unaddressed a number of fundamental questions, which require a more systematic approach for truly representative answers to be provided. For example: how frequent are SNS in different areas of the western world? How are they distributed? With what religious traditions are they associated? Also, the argument in favor of the conservation value of the SNS reviewed by the Delos Initiative has mostly relied on anecdotal evidence or overlap with PAs. The latter is certainly an important criterion, but it largely overlooks the peculiarity and specific contributions of SNS to local biodiversity patterns. This study obviates similar shortcomings by applying a systematic approach, consisting of both qualitative observations and quantitative analyses, to the underexplored domain of SNS in western contexts.

The emphasis on "western contexts" is of great relevance here: besides being a novelty in the field, it also represents a conscious response to the exhortation to bring the project of comparative ethnography back home to western societies (Latour 1993). It might be argued, in fact, that the scarce attention so far dedicated to SNS in western contexts might be due not only to perceived ecological priorities, but also to the persistence of a bias in (self-) perception, which reifies the contraposition between a rational and scientific "West", and a magic and superstitious "Rest" of the world (Latour 1993; Herzfeld 1998). In other words, we are fascinated by traditional customs and animistic beliefs, as long as we can observe them in others, but when it comes to ourselves, we are eager to see secularization and emancipation from superstition, and eschew looking in the directions that might reveal the opposite. The reality of this pattern was strongly confirmed to me during the very process of inception of this project, as my research intentions were often met by objections like: "Why would you want to look for sacred places in Italy? Are they any important there? Or do they even *exist*?". Noticeably, these are the same questions that have guided this research, but whereas I was asking them with curiosity, my critics addressed them with reluctance and skepticism. Quite interestingly, the greatest degree of reluctance and skepticism was expressed by an established nature photographer, who had spent his life photographing wildlife in Africa.

Challenging this dichotomization, in sum, has represented the first drive of this project: the body of research accumulated on TEK has shown that indigenous people conceptualize and cope with their surroundings in a more systematic and quasi-scientific way than western observers had been earlier inclined to concede. I wanted to ask, conversely, whether in our apparently secularized and disenchanted culture, organized forms of reverence for and emotional interaction with nature can be encountered, reminiscent of the numinous cosmos that we commonly associate with animistic beliefs and traditional people.

Given that main framework, an important sub-goal has been to look for evidence of the supposed ubiquity of SNS across cultures and religions. In that perspective, the choice of Central Italy as a study area appeared especially pertinent. It is a common tenet in the religion and ecology literature, that western Christianity is an essentially anti-naturalistic faith, and that by promoting an anthropocentric and mechanistic view of nature it is at the roots of the environmental crisis the world is currently facing (White 1967). How to better search, then, for a universal association between nature and spirituality, than by trying to prove the occurrence and importance of SNS even at the heart of western Christendom, where nature should be expected to be least revered and most disenchanted? Demonstrating the possible prominence of SNS in a radically different spiritual context, such as Central Italy, seemed to be highly promising for comparative purposes, and for pushing a trans-cultural agenda on the environmental distribution of sacred places. At the same time, some elements also suggested that an investigation of SNS in Central Italy would not have to be hopelessly sterile: while the idea of Christianity as anti-naturalistic is firmly rooted, traces of an ecological sensibility within the Catholic tradition are also known. Those are often related to the stories of specific saints – mostly, but not uniquely, St Francis of Assisi (Armstrong 1973; Nabhan 1993) – and hint at the possible association between spiritual beliefs and environment.

Besides these overarching questions of more general character, each chapter of this thesis addresses specific points relative to the ecology, religious background, and management of SNS in Central Italy. In turn, it is asked: How frequently are religious sites in Central Italy associated with natural landscapes or natural features? In what habitat types do they mostly occur? To what traditions within Roman Catholicism are they mainly related? Are sacred sites more diverse – as species richness and/or habitat composition – than similar, but non-sacred control sites? Are patches of old-growth forest differently conserved at sacred versus control sites? Are there differences in the use-values and distribution of useful plants at sacred versus control sites? Are there evident criticalities in the management and conservation of SNS? The data to answer these questions were collected during two intensive fieldwork sessions, which took place in Summer 2010 and Summer 2011 respectively. The data consisted of: (1) information on sacred sites' location, history, and religious background, derived from secondary sources; (2) geo-references of SNS in the study area; (3) qualitative observations on ecology, architecture, religious background, and management, gathered during reconnaissance visits at sacred sites; and (4) floristic surveys at sample SNS and paired control sites, designed for later statistical analyses.

Each chapter in this thesis, including the bulk of this introduction, is conceived as an independent unit, and represents a manuscript in ecology and conservation science, to be submitted or already accepted for publication in a peer-reviewed journal. This also accounts for possible repetitions across chapters, especially with regards to the study area description and exposition of the research methods (which, consequently, are not treated in further detail here). In all, however, the scope of this work is transdisciplinary in the sense indicated by Bürgi (1999), as the methods of one discipline (ecology) are used to answer questions from another field (cultural anthropology).

Outline of the thesis

The thesis consists of the following chapters:

Chapter two introduces the study area and offers a general overview of the main characters of SNS in Central Italy. I describe the methodological steps by which SNS were in the first place identified, and offer an analysis of the main patterns and trends relative to the sites in question, as they emerged from a systematic review of secondary sources. Successively, I integrate the description of the sites with first-hand qualitative observations and original photographic material provided by Ms. Katia Marsh, a professional free-lancer who accompanied me during part of the fieldwork. Finally, I propose a way to classify the great variety of SNS encountered in three general categories. I discuss management criticalities and research prospects for each of the categories outlined.

Chapter three is dedicated to the ecological investigation of SNS. I present the results of floristic surveys and habitat assessments conducted at thirty sample sacred sites, and an equal number of similar but non-sacred control sites. I compare sacred and control sites with regards to habitat heterogeneity, species richness, diversity indices (Shannon's H' and within-site β-diversity), forest structure, and tree basal area. Additionally, I test whether other environmental and anthropogenic factors than "sacredness" influence plant richness. The religious and ritual importance of a site is included as an explanatory variable in the model, as a first way to test evolutionary theories on religion, and the influence of ritual solidarity on the state of conservation of SNS. Finally, I discuss the results in light of ecological theory and implications for conservation and management.

Chapter four is complementary to Chapter three. While Chapter three compared sacred and control sites at the level of habitat management and conservation, Chapter four takes that same comparison to the level of individual species. For that purpose, ethnobotanical values of the flora surveyed are assigned on a regional basis, relying on a synthesis of the available literature. I then compare the frequencies of different use categories around sacred and control sites, both as an absolute count, and as a proportion of total species richness, which was known from the previous study. The influence of other factors than total species richness and site sanctity on the occurrence of useful plants is also tested. Finally, I compare the spatial distribution of large trees around sacred sites, and suggest that extra-taxonomic traits of plants, such as size, age, or taste, should be taken into more careful consideration in the study of the values of biodiversity.

Chapter five, finally, offers a synthetic review of the results from the previous chapters. I discuss the significance, but also the limitations of this study, and outline research directions that could be taken to ideally complement the present findings.

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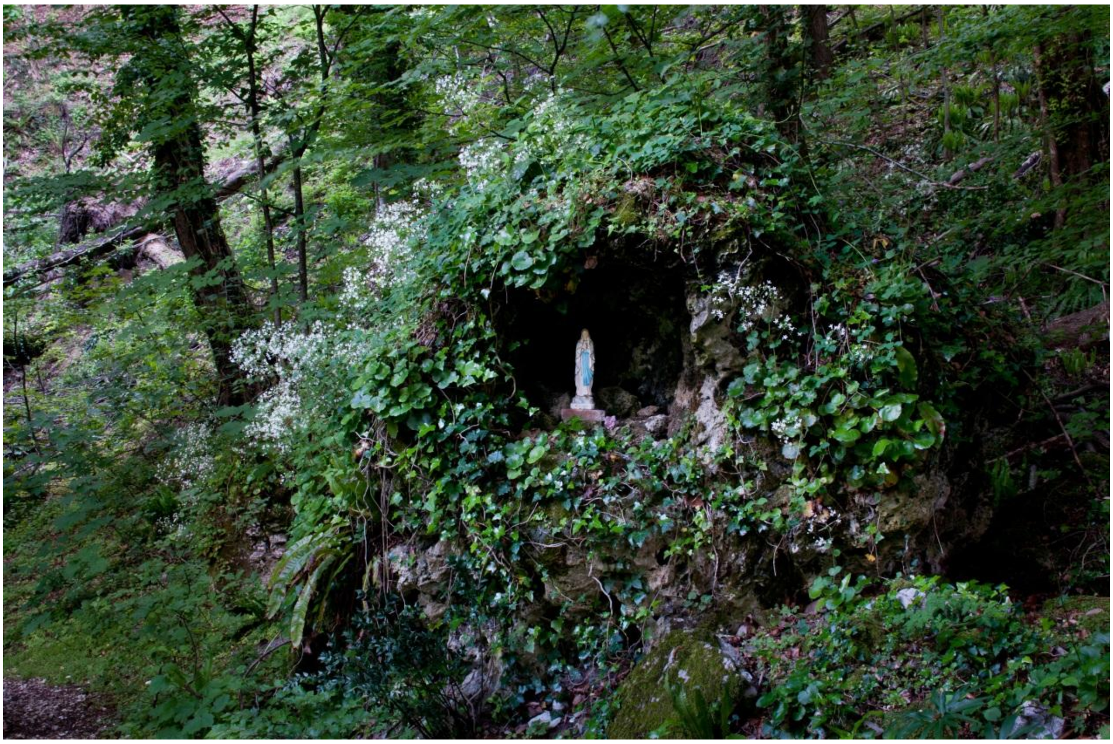
The ancient ritual of the Marriage of the Trees is celebrated at the Convent St. Angel in Vetralla, Lazio, on the 8th May of every year. Photos by Katia Marsh.

CHAPTER TWO

Catholicism and conservation: The potential of sacred natural sites for biodiversity management in Central Italy

Human Ecology, in press



Devotional statue of the Virgin Mary on the way to the Convent of St. Mary in Valdissasso, Marche (top), and ritual rubbing of stone (lithotherapy) at the Shrine of St. Venanzio in Raiano (Abruzzi). Photos by Katia Marsh.

Catholicism and conservation: the potential of sacred natural sites for biodiversity management in Central Italy

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ABSTRACT

The connection between religion, nature and conservation has become a prominent topic among scholars and conservation practitioners. Numerous studies have shown that spiritual beliefs have contributed to preserving important biodiversity in sacred areas around the world. In Western contexts, however, that link has been underexplored, perhaps due to a common view of Christianity as anti-naturalistic. Here, I rely on a literature review and first-hand observations to identify patterns and trends characterizing Catholic sacred sites in Central Italy. I show that a high proportion of the sites are located in natural areas, and that some types of sites and strands of Catholicism are associated with natural settings more frequently than others. Further, these natural sacred sites often display ecological features that highlight their important conservation role. Greater awareness and consideration of local spiritual heritages are recommended to guarantee more effective and integrated management of the sites.

Keywords: Conservation; Sacred natural sites; Biodiversity; Religion and nature; Central Italy

INTRODUCTION

The last decade has witnessed an unprecedented rise of interest in the links between religion, nature, and biodiversity conservation. The relation between faith and nature has become a growing topic of inquiry and a promising avenue for the future of conservation (Wilson 2002; Palmer and Finlay 2003; Wild and McLeod 2008). Religion, it is argued, can contribute to environmental conservation in two fundamental ways: indirectly, by influencing the way people perceive and act towards it; and directly, by enforcing actual protection of areas that are set apart by virtue of their symbolic or spiritual value (Dudley *et al.* 2006; Bhagwat *et al*. 2011).

As human geographer Yi-Fu Tuan highlights, spatial concepts of apartness and enclosure are inherent to the very etymology and notion of “sacred” (Tuan 1978). Associations of sanctity with natural and geographical features have been documented among most religions (Dudley *et al*. 2006) and on every continent except for Antarctica (Bhagwat and Rutte 2006). Further, a growing body of research has demonstrated that those holy and revered places – commonly referred to as sacred natural sites (SNS) – have often contributed to preserving significant biodiversity in different regions of East Asia and Africa (reviewed in Ormsby and Bhagwat 2010; and Dudley *et al*. 2010), to the extent that they could be thought of as “the oldest method of habitat conservation” (Dudley *et al*. 2009).

This link between sacredness and natural areas has rightly been deemed to offer crucial opportunities. At the applied level, SNS form a “«shadow» conservation network” (Dudley *et al*. 2009) that can integrate and complement existing protected areas (PAs) by conserving habitats and species not represented in official conservation schemes (Bhagwat and Rutte 2006; Ormsby and Bhagwat 2010) and improving connectivity in agricultural landscapes (Bhagwat *et al*. 2005). Moreover, by being coherent with local practices and traditions, SNS are a paradigmatic example of community-based conservation (Ostrom 1990; Berkes and Folke 1998; Colding and Folke 2001; Berkes 2004; Borrini-Feyerabend *et al*. 2007;Rutte

2011) that relies upon local people's understanding and involvement and, as such, is less prone to many of the flaws and limitations of state-driven conservation efforts (Sinclair *et al*. 2000; Stern *et al.* 2001; Brown 2003). From a more theoretical angle, the presence of a symbolic link between spiritual beliefs and the environment confirms the global prominence of "intangible" values of nature not only as fundamental and effective drivers of conservation (Jepson and Canney 2003; McCauley 2006), but also as the possible ultimate source of a conservationist ethos (Ramakrishnan 2003).

Despite the universal relevance of similar insights, the empirical study of the relation between religion and environment has remained mostly confined to animistic beliefs and traditional cultures, and touched only peripherally on Christianity or Western contexts. Interest in that direction has been increasing in recent years, partly thanks to the work of the Delos Initiative, which was promoted by members of key environmental NGOs as a first explicit attempt to methodically investigate the role of SNS in Western countries (Mallarach and Papayannis 2006; Papayannis and Mallarch 2007; Mallarach *et al*. 2010).

In studies and contributions to date, an important link between Christianity and conservation has been documented in Ethiopia, where thousands of small forest fragments encircling Christian churches are important for the conservation of woody species and forest ecosystems (Aerts *et al.* 2006; Wassie *et al*. 2010; Cardelús *et al*. 2012). Within Europe, Greece's renowned sites of Meteora (Lyratzaki 2006) and Mount Athos (Papayannis 2006; Philippou and Kontos 2007) have been pointed out as instances of the bond between environmental values and Eastern Orthodox monasticism. Also in a Catholic context, the conservation of a few forests in France and Italy is said to have directly benefited from the presence of religious settlements (Nabhan 1993; Nolan and Nolan 1997), and saints such as Pope Celestine V (Golinelli 2006) and especially Francis of Assisi (Armstrong 1973; Nabhan 1993; and Kiser 2003), have often been associated with "proto-ecological" sensibilities. Finally, a close relation between Christian sites and biodiversity-rich PAs has been highlighted by several of the case studies of the Delos Initiative (Mallarach and Papayannis 2006; Papayannis and Mallarch 2007; Mallarach *et al*. 2010). Similar evidences, however, have remained scattered, and to my knowledge no survey, mapping, or quantitative study has yet attempted to systematically investigate the occurrence and possible contribution to conservation of SNS in Western Christian contexts.

In this study, I seek to begin filling that gap. I rely on an extensive survey of Catholic sites in Central Italy and first-hand observations collected during reconnaissance visits to sample SNS, to test the relationship between sacred places and natural landscapes, and analyse patterns and characters of SNS in the Roman Catholic tradition. I build my hypotheses upon three assumptions: (1) rare but significant occurrences of SNS have been recorded in Western Europe (as reviewed above); (2) environmental attitudes can vary considerably within Roman Catholicism itself (Binde 2001), with some strands – such as the one initiated by St. Francis of Assisi – displaying a more marked “ecological” sensibility than others (Armstrong 1973; Nabhan 1993); and (3) a connection with natural elements seems to be more common among more ancient religious sites, probably due to the influence of animistic cults from the pre-Christian era (Nolan and Nolan 1997). I then examine how frequently SNS are found in a Catholic context, and their distinctive traits. I interpret the results in light of Catholic history and discuss their possible significance for conservation, management, and future research.

METHODS

Study area and religious background

Central Italy includes six administrative regions: Tuscany, Marche, Umbria, Lazio, Abruzzi, and Molise, covering more than 70,000 km^2, and falling between 41°13’22.00’’N – 44°28’41.90’’N and 9°41’26.80’’E – 14°46’58.80’’E (Fig. 1). Land morphology is characterized by the prevalence of hills (62.4%) and mountains (34.2%), whereas plains are scarce (3.3%)

Fig. 1. Central Italy includes six administrative regions: Tuscany, Marche, Umbria, Lazio, Abruzzi, and Molise.

being limited to the coastline and a few valley-bottoms. The elevations in the region are part of the Apennine Range, which traverses the peninsula from the Po Plain in the north to the tip of Calabria in the south; the highest peak is Corno Grande (2,912 masl) in Abruzzi. Almost one quarter of the land surface is part of an official PA. National Parks – the oldest form of PA in modern Italy (Sievert 2000) – cover ca.5% of the study area and include the Parks of Gran Sasso, Majella, Monti Sibillini, and the celebrated and long-established Park of Abruzzi, Lazio and Molise (Pratesi and Tassi 1998). Regional parks and other state-managed reserves account for an additional ca.7% of protected land, while the remaining portion (ca. 11%) is represented by areas more recently included in the Natura 2000 network (EU 1992), or regulated by international agreements such as the Ramsar Convention.

I chose this focus area as it is one of the most important biodiversity hotspots in Europe and in the Mediterranean biome (Myers *et al.* 2000; Olson and Dinerstein 2002), and due to its outstanding religious heritage.

Roman Catholic religious communities and institutes are organized in *orders*, which share common rules and discipline (Rapley 2005: 617-618). St Benedict of Nursia and St Francis of Assisi, both born in this area, are regarded as pivotal figures in the development of Catholicism, having founded the Benedictine and Franciscan orders, respectively. The Benedictine order, founded in the sixth century, was not the first monastic order in Western Christianity, but quickly became the most influential (Salvatorelli 1929; Dunn 2000). Its Rule prescribed (1) lifelong attachment to a single place, (2) separation from the outside world, and (3) self-sufficiency of the religious community (Sause 2003: 782; see also Wendebourg 2005: 628). Over the centuries, other orders were founded directly inspired by the Rule of St. Benedict, aimed at reforming monastic life, including the Camaldolese, Carthusians, Cistercians, and Celestines (Lawrence 1984; Leyser 1984).

The teachings of St. Francis were also largely directed at reforming what was perceived as the spreading decadence of monasticism. Franciscan brethren symbolically gave up all forms of property, accepting only charity for a living (Robson 2006). This came to be one of the fundamental distinctions between the new institutions, known as *mendicant orders,* and traditional monastic communities, which achieved self-sufficiency through land ownership and manual labor. Franciscans and Dominicans, founded in the thirteenth century by Francis of Assisi and Dominic Guzman respectively, were the first mendicant orders, but others followed, including Augustinians, Servites, and, later, Discalced Carmelites.

The thriving activities of religious institutions in Italy came to a halt in the nineteenth century due to the radical program of secularization pushed forward by the newly formed Italian state. In particular, with the “suppression laws" of 1866 and 1867 most religious goods and ecclesiastic estates were expropriated and became state properties or were sold to private purchasers (Romanato 2007). In the following decades, despite efforts to reorganize and regain lost properties, the importance and size of religious orders and the extent of their possessions never reached levels comparable to those prior to the suppression laws.

In addition to the considerable historical influence of the monastic orders, Central Italy is also dotted with pre-Christian popular beliefs and devotions which have survived and mingled with the broader religious context, giving rise to local reinterpretations of Catholic traditions. Such folk beliefs are often related to memories of local hermits and holy persons who, especially in the Middle Ages, lived as hermits, outside of the official orders, and gained reputations among local people for holiness and performing miracles. Although the Church openly discouraged this sparse army of “grassroots” ascetics and their veneration (Merlo 1989b; Dal Pino 2004; Kleinberg 2005), it never fully succeeded in uprooting the phenomenon, and occasionally was even forced by popular pressure to formalize local devotions in the worship of new saints (Geary 1986). In other cases, folk beliefs have remained more obviously associated with natural features, the cycle of seasons, and the rhythms of agricultural life (e.g., Micati 2007; De Waal 2012). Whatever their source, local folk beliefs have always represented an important religious element in all regions of Central Italy, and constitute a second fundamental source of spiritual life, sometimes integrated with, sometimes independent from the activity of the monastic orders and ecclesiastical authorities.

Data collection and sacred sites inventorying and classification

Between May and June 2010, I systematically searched public libraries and book vendors for bibliographical references to Catholic sacred sites in the study area. I was able to identify a total of nine suitable publications, mostly consisting of travel guidebooks of general character and different inspiration (Romanò 1990; Bosi 1992; Gottardo and Gamba 1994;

Cuccini and Giorgi 2000; Grasselli and Tarallo 2000; Feo 2001; Farnedi 2006; Micati 2007; Antinori 2009). These sources provided a total of 539 locations, which I inventoried and classified along 15 variables designed as to provide essential information on geographic location, site type, religious affiliation, chronology of religious history, and environmental setting (Table 1).

Table 1. List and grouping of the variables used for sacred sites inventorying

Site characterization				
Location	Site type and denomination	Religious affiliation	Religious chronology	Environmental setting
1. Region 2. District 3. Location	4. Site type 1 5. Site type 2 6. Site name	7. Order 1 8. Order 2	9. Pre-Christian site 10. Time Catholic 11. Currently active 12. Time abandoned	13. Land-cover type 1 14. Land-cover type 2 15. Altitude

Location. Geographic location of the sites was recorded according to the basic territorial subdivisions of the Italian state: administrative region, district, and municipality.

Religious affiliation. Religious affiliation was defined as the recorded presence of one of the Catholic orders. A total of 14 main orders were identified in the sources and used as levels in the classification: Augustinians, Basilians, Benedictines, Camaldolese, Canons Regular, Carmelites, Carthusians, Celestines, Cistercians, Dominicans, Franciscans, Lay Clergy, Passionists, Salesians, and Servites. Spurious occurrences of other orders were aggregated under "Others". Up to two orders were recorded for each site, although in numerous instances even more were known to have alternated at the same location. In such cases, the two more representative were selected (e.g., those credited with the foundation of the site or the longest occupation).

Site type. Site type was defined as a binary combination of four levels: convent, hermitage, monastery, and shrine. *Shrine* "refers to a place, usually the object of pilgrimages, where a relic, miraculous statue or picture, or other holy object receives special veneration" (Gillett 2003: 88); *monastery* and *convent*, although used interchangeably in common speech, literally denote the residences of monastic and mendicant communities respectively (Ryan and Espelage 2003: 231; Sause 2003: 782); *hermitage* loosely indicates the dwelling of "persons who have retired into solitude to lead the religious life" (Donahue 2003: 799) - understandably, hermitages are frequently located in deserted and remote areas. Finally, residence sites of consecrated communities can also be identified as shrines if a relic is venerated there. My classification accounted for such instances by producing combinations e.g., "convent-shrine".

Chronology of religious presence. An overview of the documented religious activity was recorded through four distinct variables. The binomial variable *pre-Christian site* indicated whether a site had also been used for religious purposes in pre-Christian times: only explicit archaeological evidence, and no indirect assumptions (such as the survival of unusual traditions or pre-Christian festival dates), were taken as a positive indication. *Time Catholic*, instead, referred to the period (generally the year, but often approximated to decade or century) in which Catholic presence started at each site, as reported in the sources. The binomial variable *currently active* reported whether a site is currently used or has lost its religious function: convents, hermitages, and monasteries are considered active if a community dwells there, shrines if they are foci of worship and visits. *Time abandoned*, finally, specified the period (year or closest approximation available) when religious abandonment of a site began.

Environmental setting. Altitude above sea level and land-cover type were used to offer a snapshot of the environment found at each site. Land-covers were classified as binary combinations of the six following levels, drawn from site descriptions in the sources: agrarian, city centre, city periphery, forest, forest traces and mountain. Use of binary combinations was motivated by the need to account for heterogeneity in land-cover around numerous sites (e.g., cultivated areas situated at the borders of urban settlements, categorized as "city periphery-agrarian"). In case of homogenous land-covers, a single factor was employed. Remote sensing imagery (Google EarthTM) was used to double-check and confirm land-covers around each site, and estimate altitude in case it was not reported in the sources. Successively, all combinations of land-cover type were organized in three meta-categories ordered along a built-natural continuum and coarsely defining environment type: built, semi-natural, and natural (Table 2). Admittedly, "natural" is a slippery term (for example, Poviltis 2002; and Ridder 2007), and even more so when applied to the highly anthropogenic landscapes of Western Europe. Here, it is loosely used as an umbrella label to indicate: (1) the prominence of vegetation cover like forests and mountain shrubs or grasslands; and (2) the absence or near absence of more intrusive land-uses, such as built areas and intensive agriculture.

Table 2. Classification of land-cover and environment types

Environment Type	Land-cover type 1	Land-cover type 2
Built	City center	
	City periphery	
Semi-natural	Agrarian	
	Agrarian	Forest traces
	City periphery	Agrarian
	City periphery	Forest
	City periphery	Forest traces
Natural	Agrarian	Forest
	Forest	
	Mountain	
	Mountain	Forest

Following this inventorying phase, reconnaissance visits were conducted at 100 sample SNS, if possible accompanied by local people. The visits took place between June 2010 and March 2011, and were aimed at acquiring a sense for the form, size, and range of diversity of SNS in the area. For that purpose, I broadly considered as SNS all religious settlements found in natural surroundings, independently of whether natural features are explicit foci of veneration at those sites. Although this might represent a relatively loose definition, it is coherent with existing literature on SNS in Europe (Papayannis and Mallarach 2007), and the observation that natural patches surrounding religious buildings are protected in many faiths, and therefore valuable for conservation potential (Dudley *et al*. 2009). During the reconnaissance, basic environmental traits were recorded, including dominant vegetation assemblages, and presence of old-growth trees or other prominent features (e.g., water, grotto). Indications of the size of the natural patch around sacred sites were derived from extant information (e.g., information panels, oral communications with local community members) whenever possible. Alternatively, they were estimated by walking through the patches and marking distances with a handheld GPS device. Observations on the size and architecture of built heritage and visible anthropogenic pressures were also noted.

Statistical analyses

Frequency distributions and descriptive statistics for relevant variables were extrapolated from the database of sacred sites compiled at the beginning of the study. To further test the hypotheses that environmental settings vary in accordance to specific orders and periods of site foundation, I produced contingency tables for each pair of variables and performed Pearson's χ^2-test of independence. Data manipulations and statistical analyses were carried out with the software R v. 2.12.2 (CRAN 2011).

Scope and limitations

The inventory of sacred sites compiled and used in this study is not a complete census of all Catholic settlements in Central Italy, nor was it intended as such. Rather, it was designed to offer an analytical snapshot of patterns and trends characterizing the relation between Catholicism and environment in the area.

Complete site characterization was not always possible, due to gaps and uncertainties in the documented history of the sites. In particular, evidences of pre-Christian worship depended on the uneven quality and availability of local studies and archaeological investigations. Similarly, indications on the age of Catholic activity were not available in 38 instances (i.e., ca. 7% of all sites), and approximated to century in another 200 cases.

Finally, systematic estimation of the size of SNS was often problematic due to uncertain property rights and lack of demarcated borders at SNS. As SNS in the area are frequently set in larger natural landscapes (e.g., forests, mountain grasslands) and not delimited by evident boundaries, in numerous cases it was impossible to clearly distinguish the area pertaining to or influenced by the sacred site from the wider natural cover through remote sensing imagery alone. Observation of certain ecological patterns (e.g., change in forest structure or species assemblages) during reconnaissance visits could occasionally hint at a border between SNS and broader landscape: when feasible, crude estimates of SNS size were collected this way.

RESULTS

Sacred sites inventory and statistical analyses

Of the 539 sacred sites identified in the study area, 307, were located in natural or semi-natural landscapes, whereas the remaining 232 fell within urban centres or predominantly built areas (Fig. 2). “City centre” was the most common land-cover type (31% of all cases), followed by “forest” (18%), “agrarian” (14%), “city periphery” (12%), and “mountain” (5%). Only a minority of sites were located in mixed land-covers.

The distribution of sacred places across environment types varied significantly for different orders (Pearson’s χ^2 test of independence: $\chi^2 = 90.10$, $df = 32$, $n = 671$, $p < 0.0001$; Fig. 3). Camaldolese were the most likely order to occur in natural areas (ca. 60%), followed by Canons Regular (40%), Carthusians (38%), Celestines (37%), Cistercians (34%), Passionists

(33%), and Franciscans (33%). Furthermore, natural locations were very frequent (54% of cases) for sacred places not explicitly affiliated with any of the orders. Institutions such as the Dominicans and Salesians were mainly confined to built environments (78% and 80% respectively).

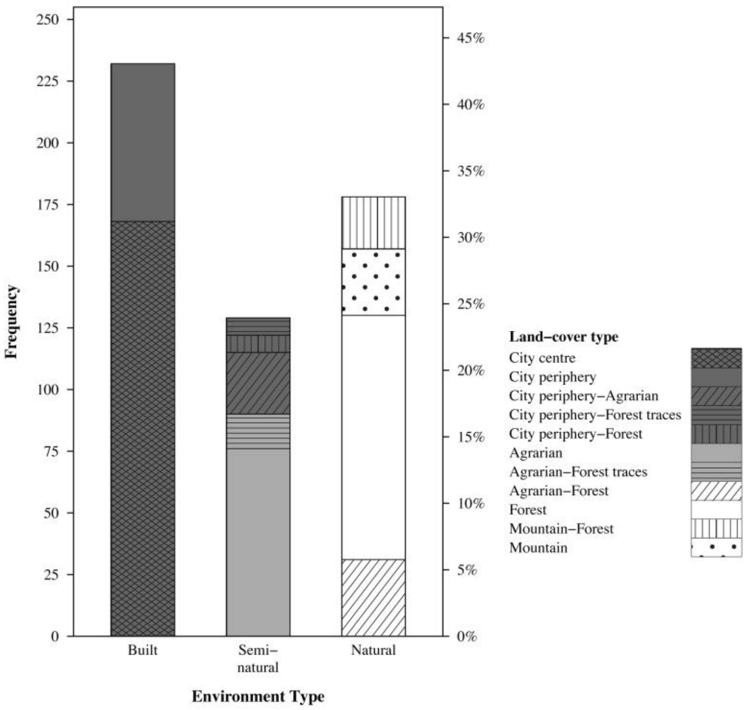

Fig. 2. Absolute and proportional distribution of sacred sites across environment and land-cover types.

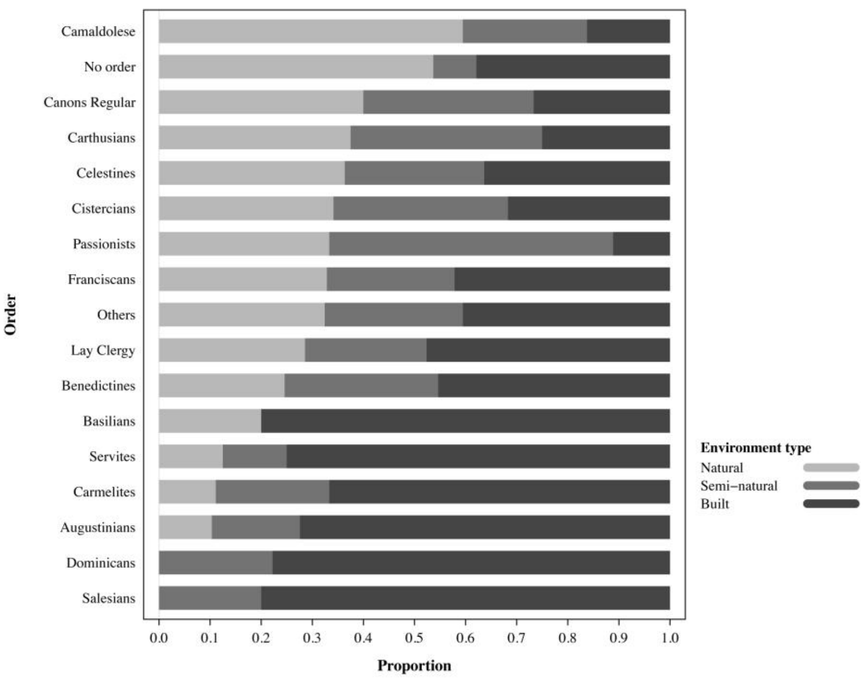

Fig. 3. Proportion of settlements located in the three different types of environment for each religious order. *Note.* Pearson's χ^2 test of independence for the relative contingency table: χ^2=90.10, *df*=32, *n*=671, *p*<0.0001.

The distribution of environment types also varied significantly across periods of site foundation (Pearson's χ^2 test of independence: $\chi^2 = 63.08$, $df = 12$, $n = 501$, $p < 0.0001$; Fig. 4). The proportion of natural and semi-natural settings was notably high (≥ 60%) for sacred sites founded during the early and High Middle Ages (i.e., 700 through 1300), while it dramatically decreased in the following periods: less than 20% of the settlements founded since the Renaissance were in natural locations.

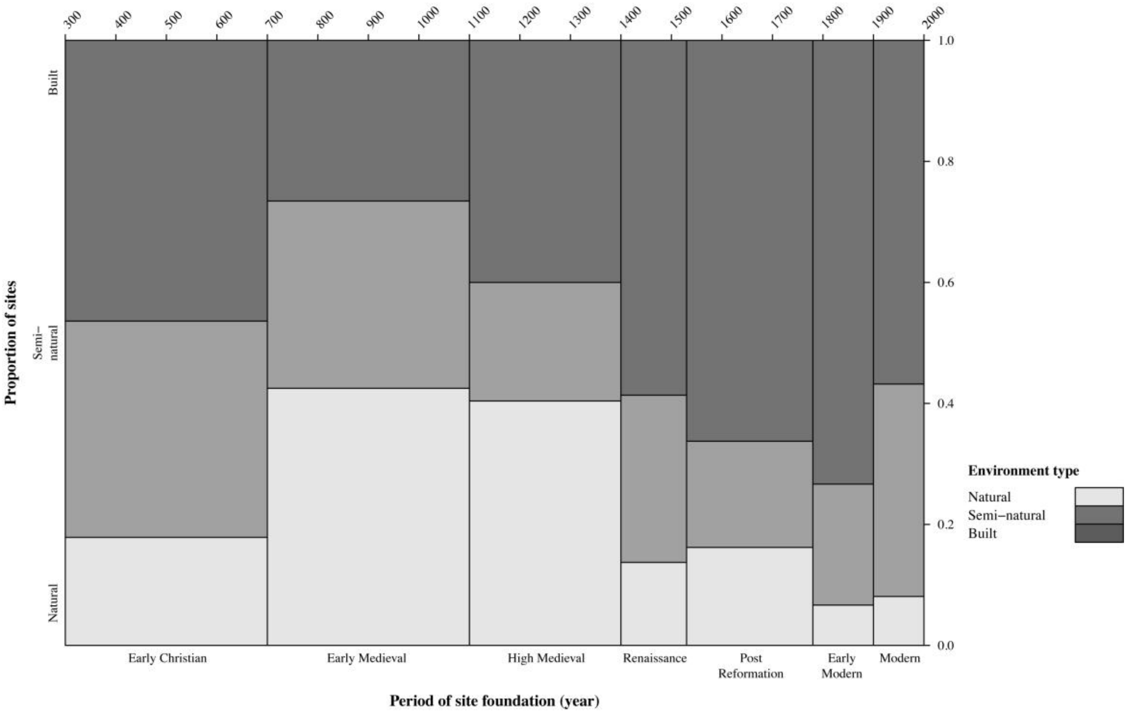

Fig. 4. Proportion of sacred sites located in each environment type by period of site foundation. *Note.* Pearson's χ^2 test of independence: χ^2=63.08, df=12, n=501, p<0.0001.

Also, natural and semi-natural sites were more likely to have been abandoned as religious centres (31% and 29% respectively), while only a very few urban sites (3%) were found to be abandoned (Table 3). The highest rates of abandonment affected hermitages and monasteries set in peripheral locations, while shrines lost their religious significance in the smallest proportion (3%) and only if located in remote areas: no shrines in urban or semi-natural contexts had been abandoned.

Finally, archaeological evidence of pre-Christian worship was found at only 23 sites (ca. 4% of the total; Table 4). A higher proportion of natural sites had pre-Christian associations than built and semi-natural ones (8%, against 5% and 4% respectively), and such evidence was substantially more frequent at shrines than other site types.

Table 3. Abandonment of sacred sites

	Environment type[a]			
Site type[a]	Built	Semi-natural	Natural	Total[b]
Convent	1 *2%*	1 *4%*	1 *6%*	3 *4%*
Hermitage	0 -	4 *67%*	37 *54%*	41 *55%*
Monastery	6 *7%*	32 *56%*	12 *40%*	50 *30%*
Shrine	0 *0%*	0 *0%*	6 *10%*	6 *3%*
Total[c]	7 *3%*	37 *29%*	56 *31%*	100 *19%*

[a] % of abandoned sites in each combination of site type and environment type.
[b] % of abandoned sites in each site type.
[c] % of abandoned sites in each type of environment.

Table 4. Pre-Christian worships at sacred sites

	Environment type[a]			
Site type[a]	Built	Semi-natural	Natural	Total[b]
Convent	0 *0%*	1 *4%*	1 *6%*	2 *2%*
Hermitage	- -	0 *0%*	1 *1%*	1 *1%*
Monastery	1 *1%*	2 *4%*	1 *3%*	4 *3%*
Shrine	6 *6%*	2 *5%*	8 *13%*	16 *12%*
Total[c]	7 *5%*	5 *4%*	11 *8%*	23 *4%*

[a] % of pre-Christian sites in each combination of site type and environment type.
[b] % of pre-Christian sites in each site type.
[c] % of pre-Christian sites in each environment type.

Reconnaissance and qualitative appraisal of SNS

The sample of visited SNS spanned from a single hermit cave to dozens of hectares of forested estate, and varied greatly also in relation to the presence and extent of historic buildings and the prominence of natural features. Site type generally was a poor predictor of those variations although it accounted for a few regularities.

Residence settlements such as convents and monasteries invariably consisted of relatively large buildings. Parcels used for subsistence agriculture and different amounts of forested estate surrounding the structures also constituted a very common feature of most residence sites (Fig. 5a). No systematic architectural patterns, however, appeared to be associated with either type: rupestral constructions dramatically leaning on steep rock faces, for example, were found in connection to both site types (Fig. 5b,c).

Fig. 5. Convents and monasteries are often found in natural settings. Clockwise from left: (a) Franciscan convent La Foresta; (b) Franciscan convent-sanctuary of Greccio; (c) Benedictine monastery Sacro Speco in Subiaco. No distinctive traits seem specifically associated with either type: agricultural parcels for sustenance agriculture (a) are common for both, and both monasteries and convents can consist of rupestral architectures carved into the rock (b-c). It is frequent, finally, that these major residences of religious communities were built around an original natural feature (i.e., grotto), sacred to a founding father such as St. Benedict (b) or St. Francis (c).

Distinctive architecture, rather, was generally (although not necessarily) related to different orders: for example, Camaldolese monasteries, Charterhouses (residences of the Carthusian order), and early Franciscan settlements of brick and stone. The terms *hermitage* and *shrine* proved to be even more vague, as they were found in a wider spectrum of sites: they could be variously an unadorned cave (Fig. 6a), modest buildings embedded in caves or in forested or mountainous surroundings (Fig. 6b-c), or monumental structures accommodating hundreds of pilgrims or supporting dozens of monks and ascetics (Fig. 6d-e).

Fig. 6. Hermitages and shrines, which account for nearly 75% of SNS in Central Italy, can refer to very different realities. Clockwise from top left: (a) a simple cave carved into the stone (hermitage St. Giovanni all'Orfento); (b) a small chapel built around a holy water spring (Water St. Franco) or (c) inside a sacred grotto (hermitage St. Angelo in Palombaro); (d) an imposing church visited by thousands of pilgrims a year (sanctuary Madonna del Canneto); (e) a large but isolated building designed to host dozens of monks and ascetics (hermitage Fonte Avellana).

Natural features were explicit objects of worship and devotion at nearly 30% of the visited SNS. These included: grottos venerated after an apparition of the Archangel Michael, or for having been the dwelling of a saint (e.g., St. Benedict at Sacro Speco in Subiaco, and St. Francis in numerous sites across the study area); particular rock formations endowed with therapeutic powers; holy water springs; and individual trees of various species (e.g., *Quercus ilex*, *Quercus pubescens*). Even when natural elements of these sorts constituted a main focus of devotion, however, historic buildings predominated, as chapels or larger structures were progressively built around or beside the original sacred feature (Fig. 5b-c, 6b-c). The only site where no building whatsoever was found was the Leccio delle Ripe, Tuscany, where an eight-century old *Quercus ilex*, sacred for having offered respite to St. Francis during one of his journeys, is venerated as a shrine: it remains a destination of pilgrimages, annual processions, and prayers, and vows are hung in its branches or placed at its roots in the form of small wooden crosses (Fig. 7a).

As indicated by the quantitative analyses above, forests were the most common type of environment found in connection with SNS. Most frequently, SNS forests were dominated by species native to the Italian sclerophyllus and semi-deciduous forests ecoregion (Olson and Dinerstein 2002): *Quercus ilex*, or assemblages of *Quercus pubescens*, *Ostrya carpinifolia* and *Fraxinus ornus*, were especially common. *Fagus sylvatica* occurred more rarely, and was generally found above 1,000 masl and in association with *Acer opalus*. Evergreen species were seldom encountered at SNS, although large covers of silver fir (*Abies alba*) were renowned for providing the basis to the sustainable forestry practices of the Camaldolese (Romano 2010), and indeed were found in connection with that order at the settlements of Camaldoli and Monte Corona.

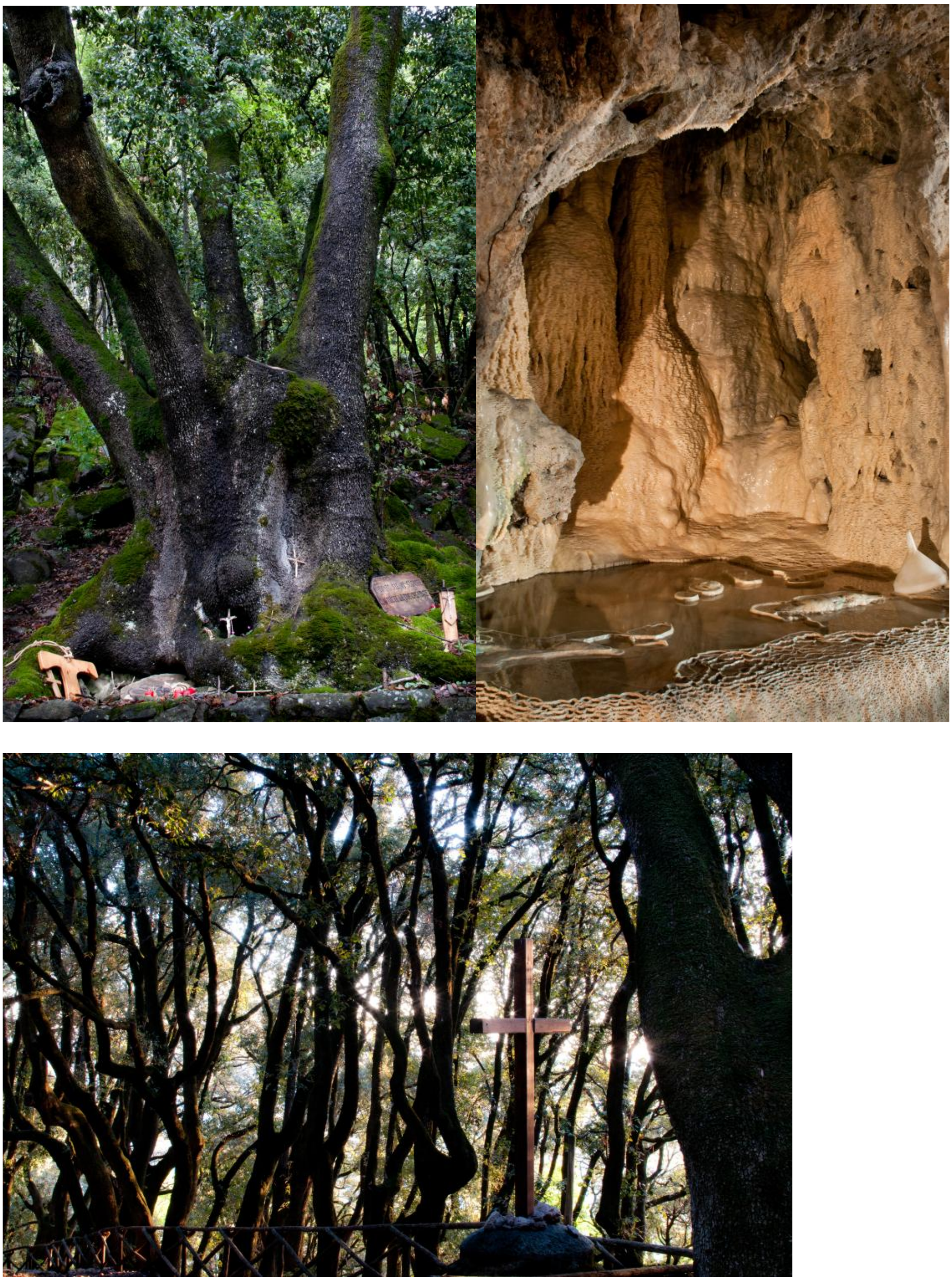

Fig. 7. Natural features have been foci of devotion and ritual practices at numerous SNS in Central Italy. From left to right: (a) the giant holm-oak Leccio delle Ripe, associated with St. Francis, is a target of vows and pilgrimages; (b) the water that percolates in the grotto of St. Michael, Liscia, is collected by the believers who consider it therapeutic; (c) the holm-oak grove of Monteluco di Spoleto was considered sacred already in Roman times, and has been associated to the nearby hermit caves and Franciscan convent since the Middle Ages.

Another distinctive association between tree species and religious orders was noted with regards to *Quercus ilex* and Franciscans. In several instances, Franciscan sites (such as

Greccio, Fig. 5b) were found to have maintained the only populations of *Quercus ilex* recognizable at the landscape level. Rare vegetation assemblages were also recorded around other SNS. These included one of the few relic parcels of beech woodland below 800 masl (hermitage of St. Maria Valdisasso) and floodplain forest (hermitage Frati Bianchi) left in the entire Marche region. In several other instances, SNS were associated with trees of notably large diameter, ranging from substantial patches of old-growth beech forest (e.g., Sanctuary Madonna del Canneto, Fig. 6d) to individual monumental specimens, such as Leccio delle Ripe mentioned above (Fig. 7a). In at least one case, forest conservation at Catholic SNS was continuous from pre-Christian times: the Franciscan convent of Monteluco di Spoleto, Umbria, lies beside an ancient holm-oak grove that was protected as a sacred site in Roman times (Fig. 7c).

In addition to similar floristic traits, an element that often characterized the ecology of SNS was the presence of a water source: karstic phenomena and percolation through calcareous rocks (Fig. 7b); water wells (as found in the courtyard of all Franciscan settlements); above ground watercourses; and mountain springs (Fig. 6b). Above ground flowing water sustained substantial patches of riparian vegetation near the sacred site.

In a majority of cases sacred sites were associated with official PAs. Of the SNS reviewed, 21 were located within the borders of National Parks (but 13 of these were hermitages and shrines found in the Majella Park alone), 10 inside regional parks and other state reserves, and 26 coincided with areas included in the Natura 2000 network. No spatial relation with official PAs was found for the other 43 visited SNS.

Finally, the size of SNS ranged from one hectare to just a fraction of a hectare for the more remote and less important shrines and hermitages (nearly 50% of cases), while the estates and areas of influence of residence sites (nearly one third of visited sites) amounted to several hectares. Only in a minority of instances did the area of SNS extend beyond 7 ha, or up to the 100 ha of *Quercus ilex* forest around the hermitage of Carceri in Assisi, and the

500 ha of mixed agrarian and forested land surrounding the Benedictine monastery of Monte Oliveto Maggiore.

DISCUSSION

While the links between religious beliefs, SNS, and biodiversity conservation have received recognition in a number of traditional contexts, they remain underexplored in the Western world. A growing body of contributions from the developing field of "ecotheology" has started to reconsider the role of the environment within the doctrines of different Christian confessions (e.g., Northcott 1996; Hessel and Radford Ruether 2000; Berry 2006; Hart 2006), but this has seldom translated into empirical investigations as to whether and how Christianity may have contributed to biodiversity conservation at specific sites. This restricted focus might have been dictated in part by perceived ecological priorities, as most of the areas recognized as biodiversity hotspots are in the tropics (Myers *et al*. 2000: 855). It is likely, however, that ethnographic bias (Latour 1993; Herzfeld 2001) and a perception of Christianity as inherently anti-naturalistic (White 1967) may be responsible (see also Mallarach and Papayannis 2010: 198-199).

The evidence presented here, although not conclusive, outlines a more nuanced picture of the relationship between Roman Catholicism and biodiversity conservation. In the first place, the very high proportion of natural and partly natural locations inventoried (Fig. 2) strongly suggests that the association between Catholicism and natural settings might be much more structural than commonly thought. This proportion is probably a conservative estimate as it relates to current land-cover around each sacred place and is likely an underestimate of originally natural locations that were later turned to different uses. Secondly, my observations indicated the potentially high conservation value of the sample locations and the frequent spiritual prominence of natural heritage within certain strands of Roman Catholicism.

The observation that “there is no single Roman Catholic view of nature, but several” is not new (Binde 2001: 16). Interpreting the environmental distribution of the inventoried Catholic settlements as an indicator of the broader relationship with nature seems to lead to a similar conclusion. A connection with natural surroundings is substantially more pronounced for certain orders and nearly non-existent for others in the study area (Fig. 3). Further, almost 30% of all SNS appear not to be connected to any order, and no reliable chronological records are available for about half of such sites. This suggests a significant association of SNS with forms of spirituality which have remained often marginal to official doctrine and religious institutions, being rather rooted in local cults and folk beliefs.

The enduring relation of SNS to folk beliefs has been taken as evidence of syncretism between paganism and Christianity (Byrne 2010; De Waal 2012). A high degree of continuity and layering of Christian sites with previous settlements is often taken for granted (Jerris 2002). It is thus surprising how low a proportion of sacred sites (4%, Table 4) have archaeological evidence indicating pre-Christian religious use. This is, however, consistent with Nolan and Nolan’s (1989,1997) findings in their census of shrines all over Europe that only 3% of all Italian sites – less than in all other parts of Europe – had documented associations with pre-Christian cults (1989; 1997). The authors hypothesized that here more than elsewhere “early churchmen were successful in uprooting loyalty to the sacred sites of the pagans” (1989: 302). Nonetheless, a more careful look at the data presented here reveals that the proportion of pre-Christian associations, while low for the whole pool of sacred sites, is higher for natural sacred sites (8%), and much higher for shrines located in natural settings (13%). This figure would seem to suggest that these “numinous sites” (Byrne 2010), once established, are less likely to lose their appeal across faiths and belief systems. Also, one or more natural features were found to constitute explicit objects of veneration at nearly all of the shrines visited, which could be additional confirmation of the particular endurance of pre-Christian traditions at natural shrines. Of the 212 shrines occurring in the inventory, only six located in natural surroundings were no longer centres of worship.

Lack of information about the start of Catholic presence at numerous sites, and gaps in archaeological records, made it hard to offer a reliable answer to the question of whether SNS are generally more ancient than other sacred places, as Nolan and Nolan suggested (1997). The data are sufficient, however, for indicating a progressive loss of importance of SNS within the Catholic tradition. This is evident from the fewer associations with natural surroundings of Catholic settlements founded from the late Middle Ages onwards (Fig. 4), and is likely related to the decreasing importance of ascetic monasticism relative to the city-based mendicant orders (Lawrence 2004). The trend is further confirmed by the higher proportions of abandoned sacred sites located in peripheral settings compared to urban ones, and abandoned monastic settlements compared to mendicant convents (Table 3).

Although lacking definitive quantitative evidence, my observations at sample SNS suggest that they have been important for biodiversity conservation in Central Italy in at least three ways: (1) preserving relic habitats and vegetation assemblages; (2) protecting old-growth forest or individual specimens (giant trees); and (3) maintaining greater habitat heterogeneity due to the presence of multiple features such as grottos, water sources, rock outcrops, forest cover, etc. Whether such ecological traits could be related to the presence of an official PA (as found at 57 of the 100 visited sites) rather than the influence of a religious centre is an open and stimulating question that deserves more attention. For the present, two considerations suggest the answer to be negative more often than not. First, although this is rarely acknowledged in historical accounts of nature conservation in Italy (Sievert 2000), the practices of religious communities often anticipated a modern conservation ethos (Romano 2010), and several important PAs have been created from centuries-old monastic estates (see below). Secondly, almost half of the protected SNS coincide with areas that have been added to the Natura 2000 network over the last 20 years, i.e., too recently to explain all the biodiversity patterns encountered at the sites in question. In similar instances, it could be claimed that the presence of religious heritages offer a chance for reinforcing the governance of Natura 2000 areas, which are too often prone to threats and disruptions if not supported by local actors and institutions (Petrosillo *et al*. 2009). In the future, it would be desirable if specific ecological studies could assess the specific conservation potential of SNS at different spatial scales, and further test and confirm these preliminary observations (cf. Byers *et al*. 2001; O'Neal Campbell 2004, 2005; Wadley and Colfer 2004; Anderson *et al*. 2005; Bhagwat *et al*. 2005; Salick *et al*. 2007).

Given the differences between various types of SNS and their land-use and management histories, a more careful insight into the dynamics by which sacred sites have benefited conservation, and how they can influence future strategies, is also required. Table 5 offers As a first overview in that direction I propose subdividing the SNS reviewed into three general categories – religious estates, shrines, and abandoned sites. – together with an outline of the basic traits, relevant stakeholders, and management challenges for each (Table 5). While this is only a preliminary assessment, it can be useful for assessing fruitful directions for future research in the field.

In some instances property and management rights over religious estates have remained with the orders (as at the Franciscan hermitage Carceri in Assisi). More often, religious lands were at least temporarily seized by the state in the nineteenth century, with consequent changes in management regimes. In some cases this resulted in dramatic disruptions, such as at the Camaldolese hermitage of Monte Corona, where 2,233 centuries-old silver firs were felled over just one year (Antinori 2009). Today, it is not unusual for such sites to be co-managed, at least to some extent, by state institutions (such as the forestry department) and the religious communities who newly inhabit them. In other instances, state managed reserves have been established on expropriated estates of high conservation value: religious orders currently live there but no longer have ownership and management rights.

Table 5. Synthetic overview of basic traits, relevant stakeholders, and management challenges for three different categories of SNS

SNS category	Types of SNS included	Ownership	Approx. size range	Historical conservation agents	Current conservation agents	Threats and criticalities
Religious estates	Active convents, monasteries, hermitages, or shrines administered by a religious order	Institutional religious community, state	5+ ha and up to 500 ha	Religious orders	Religious orders, PA	Overcrowding; trampling of spiritual values; religious communities' scarce awareness of ecological values; poor collaboration between religious communities and PA managers
Shrines	Active shrines, usually not administered by religious orders	Diocese, parish, municipality, state	< 1 ha, but up to 10 ha ca.	Local people, local parish	Local people, local parish, PA	Tourist development; erosion of traditional beliefs, practices, and social structure; scarce awareness of sites' ecological values; poor collaboration between site custodians and PA managers
Abandoned sites	Abandoned sites of all types	Municipality, state; more rarely church entity	< 1 ha, but up to 6 ha	Religious orders, local people	None, PA	Scarce awareness of ecological values; tourist exploitation; lack of relevant stakeholders for development of bottom-up conservation strategies

A significant increase in religious and secular tourism to religious sites has had negative impacts in a number of places, such as the monasteries of Vallombrosa, Chiaravalle di Fiastra, and Camaldoli, and the convent of La Verna, which are also part of important parks or state reserves (see alsoPungetti *et al*. 2007; Mallarach and Papayannis 2010). In other cases the religious communities themselves appear scarcely aware of the ecological value of the sites they inhabit, and to accord all prominence to their spiritual and artistic heritages. Further research, therefore, should explore the attitudes towards nature and environmental stewardship of the different orders, and attempt to establish partnerships between religious communities and conservationists.

Shrines constitute a rather different case than religious estates with regards to management and conservation (Table 5). Generally, shrines are not inhabited or constantly tended by religious communities, and clear borders or property rights demarcating the sacred ground around each shrine are absent or unclear. They tend to be smaller (a fraction of a hectare) than religious estates, and the local communities rather than religious orders are the major stakeholders in their management. Conservation at shrines, therefore, has relied mostly on local populations’ attitudes of respect and devotional practices, possibly codified into nature-related rituals and taboos. In general, the shrines seemed to be less prone to the negative impacts recorded at other SNS and signs of overcrowding were evident in only one case, Madonna del Canneto near Setterfrati, Lazio. However, there are signs that also the cultural mechanisms that have favoured conservation at these sites are undergoing considerable erosion. While the nature-based rituals and devotions that have long characterized many shrines are still vigorous and deeply rooted in some contexts (De Waal 2012), they appear on the wane in many others (Antinori 2009; Micati 2007). Also, new construction around sacred natural features has been underway at several shrines for the last decades. Together with the loss of traditional ecological knowledge in the study area (Idolo *et al*. 2010), these factors could severely undermine ongoing ecological conservation at SNS of this kind. While it might be impossible to radically intervene to reverse such trends, explicit involvement with local communities would still be a priority. This would have the goal both to document traditional beliefs and practices that constitute a rapidly disappearing legacy of biocultural diversity, and raise awareness of the desirability for sensible ecological management of SNS.

Finally, a number of abandoned sites have remained prominent landmarks in certain landscapes, or acquired the status of monuments and tourist destinations. Of the 56 abandoned SNS censused, 12 ceased to be religious centres following the nineteenth-century expropriations, and the other 44 even earlier, although no clear dates are available. The imprint of the former religious settlements on the surrounding ecology is apparent at numerous sites, as also found in comparable contexts (Dambrine *et al*. 2007). In some instances, this special character has been recognized, and abandoned SNS have become an important part of official PAs, such as the many hermitages in the Majella National Park, or the Camaldolese settlement Frati Bianchi in Cupra Montanta. In other cases, however, they have remained outside official conservation schemes, although field observations suggested that they might also have played a significant role for local biodiversity. Assessing their ecological biodiversity and establishing whether and how they could enrich the existing PAs network would be a desirable step.

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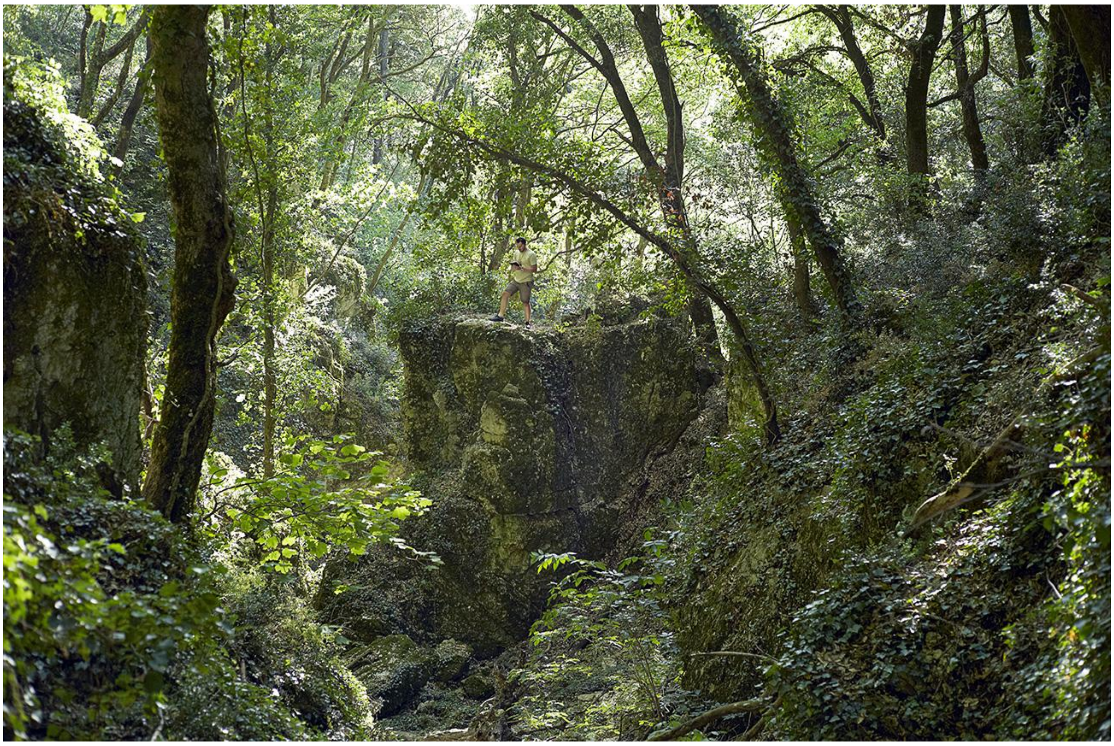
CHAPTER THREE

Shrines in Central Italy conserve habitat diversity and old-growth forest

To be submitted to *Biological Conservation*



Sampling the sacred forests in Assisi. Photo by Justin Guariglia. Property of the National Geographic™

Shrines in Central Italy conserve habitat diversity and old-growth forest

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ABSTRACT

It is increasingly recognized that successful conservation in anthropogenic land mosaics and beyond traditional protected area schemes is becoming key for preserving significant amounts of biodiversity. In this perspective, sacred natural sites have come to the forefront of conservation practice for their ability to guarantee effective conservation of natural land patches on the grounds of local values and institutions. However, while the conservation value of sacred places in various areas of Asia and Africa (where customary practices of conservation are still upheld by many communities) has been repeatedly proven, such a link has hardly been quantitatively tested in the Western world (where customs and traditions have, arguably, lost their importance due to modernization and secularization). To address whether sacred natural sites in the developed world also retain their value for conservation of biodiversity, we studied forest structure and plant diversity at 30 representative sacred natural sites in Central Italy, and used a paired design to compare them to 30 non-sacred control sites with similar habitat and environmental traits. We demonstrate that sacred sites are important for preserving giant tree specimens and patches of old-growth forest in the study area. Further, they harbour more plant species than control sites, exhibit a more heterogeneous habitat structure, and significantly contribute to β-diversity at the landscape level. We suggest that such patterns are likely related to structural environmental features at the sites, but also to traditional, low-intensity forms of anthropogenic activity which remain pivotal for preserving site diversity and conservation value.

1. Introduction

There is increasing recognition that the fate of much biodiversity will largely depend on successful conservation outside of protected areas (PAs) and within anthropogenic land mosaics (Halladay and Gilmour 1995; Bengtsson et al. 2003; Willis et al. 2012). On the one hand, this is due to limitations inherent to existing PA networks, which include limited proportions of lowland habitats, while mountainous and remote areas are disproportionately represented (Rodrigues et al. 2004; Chape et al. 2005; Dietz and Czech 2005; Joppa and Pfaff 2009), or suffer from encroachment, lack of support from local populations, or other anthropogenic pressures (Dudely et al. 2004; Wittmeyer et al. 2008; Wade and Theobald 2010; Mackenzie et al. 2012). On the other, the importance of heterogeneous landscapes and farmland mosaics for supporting high biodiversity and species not found within PAs has been highlighted, for example in relation to birds (Santos et al. 2008; Pautasso and Dinetti 2009). In a number of instances, specific cultural practices or traditional farming regimes have even been indicated as pivotal for maintaining species-rich grasslands (Maurer et al. 2006) and agro-forestry landscapes (Parrotta and Agnoletti 2007), both within and outside PAs.

In such a context, over the last decade particular attention has been dedicated by conservation specialists to sacred natural sites (SNS). SNS are defined by the International Union for the Conservation of Nature (IUCN) as “areas of land or water having special spiritual significance to peoples and communities” (Wild and McLeod 2008). They are found in indigenous belief systems and mainstream faiths alike (Dudley et al. 2009) and on every continent except Antarctica (Bhagwat and Rutte 2006), so that they can be regarded as a nearly universal phenomenon (Berkes 1999). From a conservation perspective, SNS have been considered as paradigmatic examples of community-based resource management (Rutte 2011), where the conservation or sustainable use of biodiversity is a consequence of a set of shared values and practices, deeply embedded in local cultures and belief systems

(Colding and Folke 2001; Jones et al. 2008). Further, SNS do not necessarily represent patches of untouched nature, although that might occasionally be the case, but are instances of management regimes that support rather than disrupt biodiversity (Sheridan and Nyamweru 2008; Sheridan 2009).

A growing body of literature has demonstrated that SNS actively contribute to biodiversity conservation in several regions of East Asia and Africa, where they are still related to taboos and social norms that regulate the exploitation of natural resources (Tengö et al. 2007; Jones et al. 2008; Ormsby 2011). Although cultural change triggered by development, and abandonment of traditional livelihoods are eroding these areas of customary conservation (Ormsby and Bhagwat 2010; Bossart and Antwi 2013), SNS in those regions are still found to harbour significantly higher diversity than surrounding landscapes or neighbouring PAs (reviewed in Dudley et al. 2010). A similar relation, however, has hardly been quantitatively tested in European contexts, although in recent years a number of case studies have begun to explore it (Mallarach and Papayannis 2006; Papayannis and Mallarach 2007; Mallarach et al. 2010). This represents a surprising gap in knowledge that requires being obviated: an accumulating number of studies have shown that also in Europe the survival of biodiversity is often linked to customary management practices and traditional knowledge (Schmitz et al. 2012; Otero et al. 2013), which have been maintained in spite of economic pressures and land use changes. The identification, understanding, and conservation of these cultural landscape hotspots should be considered one of the most prominent conservation priorities in a European context (Solymosi 2011).

In a previous preliminary study (Frascaroli, in press), we showed that a spatial association with natural landscapes is remarkably common for Catholic sites in Central Italy, and identified almost two hundred SNS in the area. The choice of that study region was motivated by its naturalistic interest, coinciding with one of the main biodiversity hotspots in Europe (Myers et al. 2000, Olson and Dinerstein 2002), and outstanding religious heritage.

Based on a review of sample sites, we also highlighted their diversity with regards to religious characters and forms of management and underlined that a number of ecological traits might support the hypothesis that the sites in question have played an important conservation role in the region.

Here, we build upon those insights and use first-hand floristic assessments and a design based on paired comparisons between sacred and similar non-sacred sites, to empirically test the conservation value of a subset of SNS in the same study area. We ask the following questions: (1) Do sacred sites support higher plant diversity than similar non-sacred control sites? (2) Are occurrences of old-growth forest more common in sacred than non-sacred sites? (3) Are sacred sites more heterogeneous than non-sacred control sites as habitat composition? (4) Are sacred sites more diverse than control sites within as well as outside of official PAs? (5) Does religious importance affect diversity at different sacred sites? And (6) what other environmental and anthropogenic factors influence species diversity at sacred and control sites?

2. Methods

2.1 Study area

Central Italy extends between 41°13’22.00’’N – 44°28’41.90’’N and 9°41’26.80’’E – 14°46’58.80’’E and includes the regions: Tuscany, Marche, Umbria, Lazio, Abruzzi and Molise (Fig. 1). Geomorphology is characterized by the prevalence of hills (62.4%) and mountains (34.2%), whereas plains are few (3.3%) and mostly limited to the coastline and valley-bottoms. Nearly one quarter of the land surface is included in some conservation scheme: 12% ca. is part of PAs registered in the Official List of Protected Areas (OLPA), while an additional 11% ca. falls within the borders of Sites of Community Interest and Special Protection Areas constituting the Natura 2000 network (EU 1992).

Fig. 1. Map of Italy showing the five regions that constitute the research area and the 30 study sites (each site is marked by a unique identification code; for sites overview see Table A.1 in the Apendix).

2.2 Sites selection

To identify pertinent research sites, we relied on a classification and mapping of SNS in Central Italy elaborated in a previous preliminary study (Frascaroli, in press). There, it was highlighted how associations of Catholic sacred sites with natural habitats and environmental features are much more frequent, than assumed on the bases of a common view of Christianity as anti-naturalistic (White 1967): of 539 Catholic sites inventoried, ca. one-third were located in forested or mountainous landscapes. Also, the distinction was introduced between worship sites, used for religious celebrations by local peasant communities, and residence sites, where institutional groups of religious brethren reside:

the two categories are substantially different concerning religious function, environment, and management, so that studying them separately appears advisable.

In this research, we opted for focusing exclusively on shrines because they are most similar to the model of community-based resource management, to which SNS are associated in other studies (e.g., Ormsby 2011). A shrine is defined as “a place, usually the object of pilgrimages, where a relic, miraculous statue or picture, or other holy object receives special veneration” (Gillett 2003: 88). Natural shrines can range from a small chapel, or even a simple icon hung on a tree, to large temples surrounded by forest. They are often related to the life stories of saints, local beliefs, and other forms of popular devotion, including the invocation of natural elements (De Waal 2012): they are manifestations of folk spiritualities and religious syncretism, tightly associated to the livelihoods and traditions of local people. Most of the shrines reviewed were founded during the Middle Ages, although in more than 10% of cases there are also traces of older, pre-Christian worships (Frascaroli, in press).

For this study, we integrated the list of natural shrines in Central Italy from our preliminary research, with the information made available by the project *Censimento dei Santuari Cristiani in Italia* (“census of Christian shrines in Italy”, 2003), sponsored by the Italian Ministry of Cultural Heritage. We utilized this additional source in order to enlarge the potential pool of study sites and include a number of shrines of outstanding religious importance, which fell out of the methodological scope of our previous study. From our final list, we then extracted a sample of thirty sites stratified, so that the final sample respected the following criteria: (1) being evenly distributed across the administrative regions of the study area; (2) being as balanced as possible between sites located within official PAs and sites located outside; (3) being representative of the different habitat types commonly associated with SNS in Central Italy (Frascaroli, in press); and (4) being ordered along a continuum of religious importance (from nearly abandoned and rarely visited sites, to popular hubs that attract dozens thousand pilgrims a year). The information about religious importance had been previously obtained through semi-structured interviews with shrine custodians. An overview of the fundamental traits of the thirty sample sites is shown in Table A.1 in the Appendix.

Successively, each sacred site in the sample was paired with a comparable control site located in a non-sacred area nearby, as done by Salick et al. (2007). To identify the control sites we walked along a visible track away from the sacred site, until a parcel with analogous elevation (± 200 m; mean ± SE of altitudinal difference between sacred and control sites: 54.7 ± 8.3 m), aspect, and habit type (e.g., *Quercus ilex* forest) was encountered. We attempted to select control sites that were located in a habitat patch as clearly distinct as possible from the patch around the sacred site (e.g., being separated by the presence of another habitat fragment, or by an evident feature such as a road). Satellite-based land-cover maps *GlobCover 2009* (ESA 2010) and geographic information system (GIS) software (ESRI 2010) were used to assist with identifying suitable control sites. In four instances, we found that the habitat around sacred sites (once *Fagus sylvatica*- and *Ostrya carpinifolia*-dominated forest, and twice *Quercus ilex*-dominated forest) was the single occurrence recognizable at the landscape level. In such cases, we selected control sites that matched the sacred area as land-cover but not strictly as vegetation type (i.e., respectively, *Fagus sylvatica* and *Picea abies* forest, twice *Quercus*-dominated deciduous forest, and *Castanea sativa* dominated forest with occurrences of *Quercus ilex*).

2.3 Vegetation sampling and data collection

To sample trees, we laid one to three 100 m^2 (25 m x 4 m) transects at each sacred site, and recorded species and size (DBH) of all mature trees (i.e., ≥ 10 cm DBH) rooted within. The number of transects varied according to local geomorphology: while we always tried to maximize sampling intensity, in numerous instances sampling efforts were limited by natural impediments (e.g., presence of cliffs). The transects were laid adjacent to each shrine, where the natural patch started, and stretched 25 m away from the shrine. When feasible, orientation of the first transect at each site was randomly determined, while the following ones were positioned so as to divide the remaining sampling space in equal parts and evenly cover the area.

To sample understory vegetation, we nested three 1 m^2 subplots within each transect (one at each end, and one in the middle), for a total of three to nine 1 m^2 subplots at each site. Species ID and estimated cover percentage were recorded for all vascular plants inside the subplots, including herbaceous and shrub layers and tree canopy projections. Specimens of each species were collected and dried for later identification.

As an indication of habitat composition, finally, we noted the occurrence of different micro-habitat types in a buffer of 25 m around each shrine, and an estimate of their relative cover. Sixteen levels were used to classify micro-habitats (Table A.2 in the Appendix).

The same sampling design used at a sacred site, including extent of sampled area, number and orientation of transects, collection methods, and assessment of habitat composition, was successively replicated at the relative control site. Overall, 63 transects and 189 subplots were laid across the 30 sacred sites, and as many across the 30 control sites. Sampling and data collection at all sites were conducted in summer 2011.

2.4 Statistical analyses

2.4.1 Diversity indices and comparison of sacred and control sites

Total species richness, species richness/100 m^2, species diversity (Shannon-Weiner's H' based on individual counts; Magurran 1988), tree density (stems/hectare), and tree basal area (m^2/ha) were calculated for the transect data from each site. Total species richness, species richness/1 m^2, species diversity (Shannon-Weiner's H' based on cover estimates), and within-site β-diversity (1 – Jaccard Index of similarity between all plots at a site;

Magurran 1988), instead, were extrapolated from the 1 m^2 plot data. Finally, number of micro-habitat types, index of natural habitat heterogeneity (Shannon-Weiner's H'), and proportion of anthropogenic or degraded land at each site (i.e., roads, dirt tracks, construction sites or built environment) were computed.

To compare habitat composition, tree density, tree basal area, species richness, and diversity between sacred and control sites, we used paired t-tests if the assumptions of normality and equal variance of the data were respected, and Wilcoxon sign-rank tests for two related samples if the data had non-parametric distributions. The tests were run on a log-transformation of the response variable, if this enabled to meet the assumptions of normality and homoscedasticity.

2.4.3 Species richness per site

We rarefied by area the total number of species found at each site in order to equalize sampling intensity. Using GIS software (ESRI 2010), we calculated the distance of each site from the nearest PA, and the number of different *GlobCover 2009* (ESA 2010) land-cover types in a buffer of 1000 m around each site. As an index of macro-habitat diversity, we computed Shannon's H' using the area occupied by each land-cover type in the 1000 m buffer. We then performed analysis of variance (ANOVA) on a linear model, having confirmed assumptions about normality and equal variance of the data, to test whether the rarefied number of species at each site depended on landscape and habitat heterogeneity (respectively, number and diversity of macro-habitats in a 1000 m buffer around the site, and number and diversity of micro-habitats at the site), environmental factors (altitude, tree density, and habitat type), cultural and anthropogenic factors (religious importance and distance from PA), or other sources of variability (geographic location).

All statistical analyses were performed with the software R version 2.15.2 (R Core Team 2012).

3. Results

3.1 Comparison of sacred and control sites

3.1.1 Habitat diversity

Overall, we recorded a larger number of distinct micro-habitat patches at sacred sites than control sites (Table A.2 in the Appendix). Further, we found that certain types of natural micro-habitat occurred exclusively (grotto, meadow) or nearly exclusively (water source) at sacred sites. Anthropogenic micro-habitats, however, were also much more common at sacred sites, where 35 patches were counted versus 16 at control sites. Finally, broadleaf closed-canopy forest was the micro-habitat type encountered most frequently at both sacred and control sites, with twenty-six and twenty-two occurrences respectively.

Statistical analyses confirmed that both the mean number of micro-habitats and habitat heterogeneity as measured by the Shannon's index were significantly higher at sacred sites ($t = -4.558$, $df = 29$, $p < .0001$ and $t = -4.760$, $df = 29$, $p < .0001$ respectively; Fig. A.1a-b in the Appendix). Similarly, also the proportion of anthropogenic or degraded area estimated at sacred sites was found to be considerably larger than at control sites (mean ± SE: 11.4% ± 2.6% versus 2.3% ± 0.7%; $z = 3.874$, $p < .0005$; Fig. A.1c in the Appendix).

3.1.2 Tree size and forest structure

While control sites generally hosted more of the smaller trees, we found that the larger diameter classes occurred more frequently at sacred sites (Fig. 2). On average, we recorded 78 ± 28 (mean ± SE) stems per hectare with DBH ≥ 40 cm at sacred sites, versus 28 ± 12 at control sites. Overall tree density, however, was not significantly different, and ca. 850 stems per hectare were counted at both sacred and control sites (Fig. A.2a in the Appendix). Forest cover as represented by total basal area, instead, was considerably larger at sacred sites (mean ± SE: 54 ± 7.3 m^2/ha versus 27 ± 3.3 m^2/ha; $t = -4.625$, $df = 29$, $p < .0001$; Fig. A.2b).

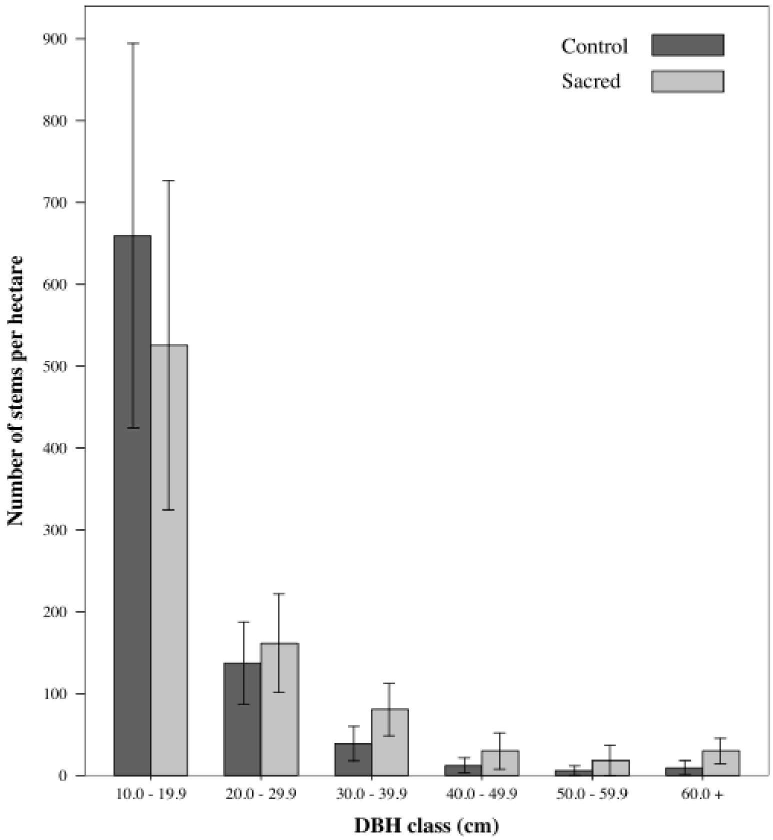

Fig. 2. Mean number of tree stems per hectare in different diameter classes. Error bars indicate 95% confidence intervals.

3.1.3 Tree and plant diversity

Altogether we recorded 351 different plant species in the 378 study plots. Of those, 146 were found uniquely within the plots at sacred sites, 84 were limited to control sites, and the remaining 136 occurred at both types of site.

Tree species richness, tree richness per area, and tree diversity (Shannon's H') were marginally higher at sacred sites (Fig. A.3 in the Appendix). These differences, however, were not statistically significant. On the contrary, we found that significant differences between sacred and control sites occurred concerning the richness of all plant species (mean ± SE: 20 ± 1.7 versus 16 ± 1.5; z = 3.175, p = .0015; Fig. A.4a in the Appendix) and the richness of plant species per area (10.2 ± 0.9 species/m^2 versus 8.2 ± 0.8 species/m^2; t = −3.365, df = 29, p = .0021; Fig. A.4b). There were not significant differences in Shannon's index (Fig. A.4c), while higher β-diversity was recorded within sacred sites (0.75 ± 0.02

versus 0.65 ± 0.02; $t = -4.100$, $df = 29$, $p = .0003$; Fig. A.4d), indicating greater variation in species composition between the plots at each site.

Important β-diversity patterns were also recorded at a larger scale, considering a set of paired sacred and control sites as the basic spatial unit. Overall, for each pair we recorded a mean richness of 29 plant species (SE: ± 2.5, Table 1). Of those, 44% (SE: ± 2.3%) were contributed by sacred plots, 29% (SE: ± 2.6%) by control plots, while the remaining 27% (SE: ± 2%) were shared by both. These differences in proportions were tested to be statistically significant ($t = 3.486$, $df = 29$, $p = .0016$, and $t = 5.063$, $df = 29$, $p < .0001$). Significance was confirmed also after adjusting the contribution of unique species for the total number of species recorded within the plots: of 100 plant species found in sacred plots, 62.5 (± 2.4) were a unique contribution to the overall diversity of the sampling pair, versus 51.4 (± 3.6) species found at control plots ($z = 2.910$, $p = .0036$).

Table 1 - β-diversity patterns within sampling pairs of sacred and control plots, indicating (1) the number (mean ± SE) of plant species restricted to sacred plots, restricted to control plots and shared by the two, (2) the proportion they represent within sampling pairs, and (3) the ratio of unique species out of all species in sacred and control plots

Distribution of plant species	Number of species	Proportion [a] within sampling pair	Proportion [b] within type of site
Species restricted to sacred plots	12.8 ± 1.2	44.4% ± 2.3%	62.5% ± 2.4%
Species restricted to control plots	8.6 ± 1.0	29.0% ± 2.6%	51.4% ± 3.6%
Species shared by sacred and control plots	7.3 ± 0.7	26.7% ± 2.0%	
Total	***28.7 ± 2.5***	***100%***	

[a] Indicates the proportion of species, out of the total number of species found at each sampling pair

[b] Indicates the proportion of unique species, out of species richness found at sacred or control plots within a sampling pair

3.2 Factors affecting plant diversity

Richness of plant species rarefied by area varied significantly across geographic regions ($p < 0.005$, Table 2) and locations ($p < 0.01$), as well as different habitat types ($p < 0.001$). Alpine grasslands and mixed habitats consisting of dry grassland and deciduous forest patches hosted the highest numbers of plant species (mean ± SE: 18.1 ± 2.9 and 19.2 ± 1.3 respectively; Fig. 3). Mixed deciduous forests generally were less species-rich (mean ± SE: 14.9 ± 1.5), although they presented a broader range of variability. *Fagus* forests and mixed conifers, finally, were recorded as the least speciose habitats (mean ± SE: 8.4 ± 1.4 and 8 ± 2.2 respectively).

Table 2 - Summary table of sequential sum of squares ANOVA, testing the incidence of cultural variables, environmental factors and geographical position on rarefied plant species richness

Explanatory variable	df	SS	F	p	
Site type (sacred vs. control)	1	86.08	13.135	< 0.005	*
Religious importance	3	80.33	4.173	< 0.05	*
N land cover types	1	12.67	1.975	0.180	
H' landscape	1	24.08	3.753	0.072	"
N natural habitats	1	14.27	2.225	0.157	
H' natural habitats	1	89.17	13.897	< 0.005	*
Altitude	1	0.62	0.097	0.760	
Tree density	1	191.05	29.776	< 0.001	*
PA	1	1.19	0.185	0.673	
Distance from PA	1	36.26	5.651	< 0.05	*
Habitat type	6	395.24	10.267	< 0.001	*
Region	4	187.12	7.291	< 0.005	*
Location	21	466.55	3.463	< 0.01	*
Site type : distance form PA	1	57.1	8.899	< 0.01	*
Residuals	15	96.24			

(*) Significant variables ($p \leq 0.05$)
(") Marginally significant variables ($p \leq 0.10$)

Among the other environmental variables tested, we found that the number of micro-habitat types around sampling sites and altitude did not have a significant influence on plant species richness (Table 2). On the contrary, heterogeneity of habitat composition had a significant incidence (p < 0.005, Table 2), as more heterogeneous habitats supported species-richer plant assemblages (Fig. 4a). Increasing landscape heterogeneity was also associated with greater species richness (Fig. 4b), although this effect was only marginally significant (p < 0.10, Table 2). Finally, plant diversity was strongly affected by tree density (p

< 0.001, Table 2), and less plant species were found as the number of tree stems per area increased (Fig. 4c).

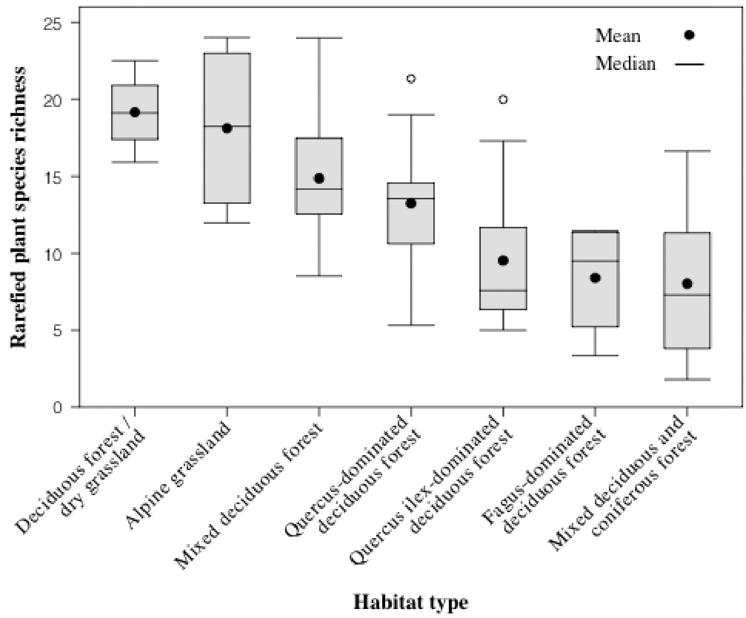

Fig. 3. Distribution and mean values of plant richness in the seven macro-habitat types encountered at the study sites.

As also demonstrated above, a significantly higher number of species was found in sacred sites compared to control sites ($p < 0.005$, Table 2). That effect, however, was uneven for sacred sites of different importance ($p < 0.05$, Table 2): species richness at the less important shrines was likely to be higher, although it also showed greater variation than that recorded at the most important sites (Fig. A.5 in the Appendix).

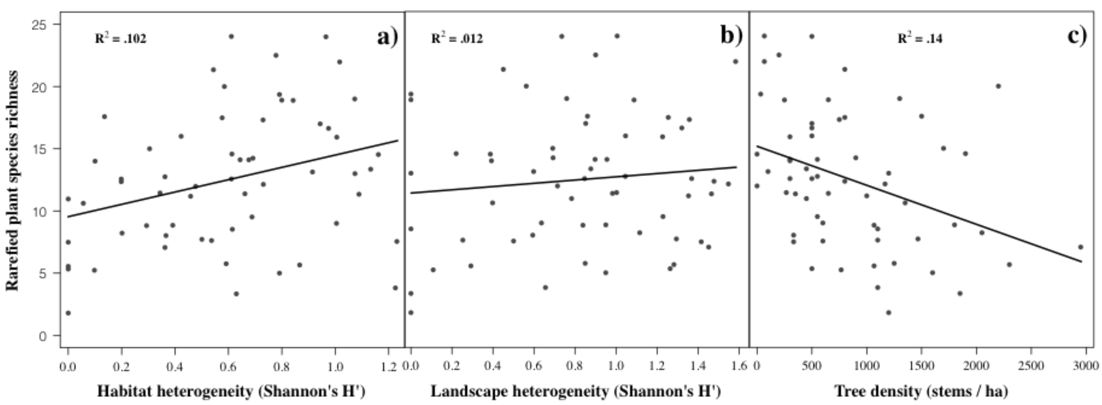

Fig. 4. Relationship between plant species richness and the habitat heterogeneity (a), landscape heterogeneity (b), and tree density (c) found at the study sites.

The influence of official land protection, instead, was less straightforward. Overall, there was nearly no difference in plant species richness between sites located within and outside official PAs (mean ± SE: 12.4 ± 1.1 and 12.5 ± 0.9 respectively). The picture changed, however, when the interaction between official protection and protection based on "land sanctity" was also considered ($p < 0.01$, Table 2). We found that the difference in plant richness between sacred and control sites remained marginal within PAs (mean ± SE: 13.1 ± 1.5 and 11.8 ± 1.1 respectively, Fig. 5), but progressively widened as control sites lost species and sacred sites became species-richer the farther away they were located from PAs.

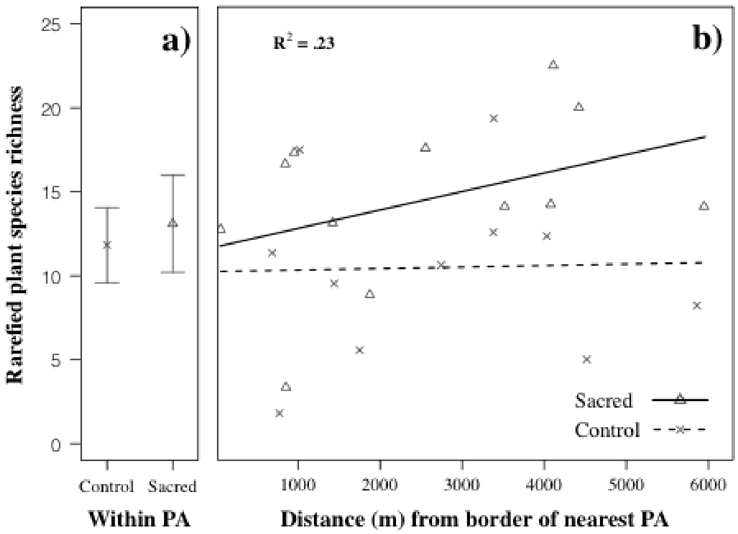

Fig. 5. Mean number of plant species at sacred and control sites within PAs (a), and relationship between plant species and distance from PA at sacred and control sites not included in PAs (b). Error bars indicate 95% confidence intervals.

4. Discussion

4.1 Influence of sacred sites on conservation

Our analyses and comparisons suggest that also in Central Italy sacred sites are associated with noticeable biodiversity and conservation values, although the benefits are not unequivocal. Larger portions of anthropogenic and artificial areas were encountered at sacred than control sites, underlining a detrimental impact. Within natural habitats, however, SNS displayed significantly higher biodiversity values than control sites. This confirms that informal conservation regimes, hinging on spiritual motives and a culturally transmitted set of regulations, can still be found in Western non-traditional contexts, even in face of secularization, economic development, and widespread rural abandonment (De Arazanbal et al. 2008). Indeed our results are consistent with patterns found in as diverse parts of the world as Tibet, where SNS are associated with giant tree specimens (Salick et al. 2007), and Tanzania, where sacred groves support higher species richness than neighbouring forest reserves (Mgumia and Oba 2003).

4.1.1 Conservation of old-growth forest

The findings on tree size and forest structure likely represented the most clear-cut outcome of our comparison between sacred and control sites, and they allow the conclusion that sacred sites have been important for conserving patches of old-growth forest or at least individual specimens. Total basal area, in fact, was remarkably higher at sacred sites than control ones (Fig. A.2 in the Appendix), while stem densities were nearly identical, suggesting that forest cover at sacred sites is significantly older than at control ones. Further, the mean density per hectare of trees ≥ 40 cm DBH recorded around shrines (78 ± 17.9) is congruent with the definition of old-growth forest elaborated by the Italian Ministry of Environment (Blasi et al. 2010), which based on the calculations of Nilsson et al. (2002) considers as “old-growth” forest sites where the density of trees ≥ 40 cm DBH is at least of 70 stems per hectare.

In other cultural contexts, it has been assumed that the relation between SNS and giant trees reflects local customary prohibitions on timber extraction (Salick et al. 2007), and that similar regulations may even entail awareness of ecological processes and sustainable resource usage, although mediated by traditional values and spiritual motives (Wadley and Colfer 2004). A similar interpretation might apply here, where forest ecosystems played a crucial role for rural livelihoods up to the 1970s (Blondel et al. 2010), although also purely intangible values, such as aesthetic appreciation and sense of continuity with the past, are frequently associated with ancient trees (Blicharska and Mikusinski 2013), and can constitute important drivers of their preservation in religious contexts (Nolan and Nolan 1997; Byers et al. 2001; Turner et al. 2009).

4.1.2 Plant diversity and habitat heterogeneity

Species richness and richness per area were found to be significantly greater at sacred than control sites (Fig. A.4 in the Appendix). Besides statistical significance, however, it can be seen that the magnitude of those differences is rather small. Indeed the species richness recorded at sacred sites are in no way unusual for similar ecosystems in Central Italy (Bacaro et al. 2008), nor do they translate in higher Shannon's diversity. In this sense, it would probably be improper to speak of our sites as actual "biodiversity hubs", although "land sanctity" might certainly have played an active role in supporting some diversity patterns.

According to our model, habit and land-use heterogeneity at different spatial scales were important factors in determining plant richness (Table 2). This is congruent with other studies that associate greater species richness with higher habitat diversity (Duelli 1997; Moser et al. 2002), especially when this relation considers dynamics at the level of small plots (Pausas and Austin 2001). One of the most evident differences we detected between sacred and control sites was the more complex habitat composition of the former (Fig. A.1 in the Appendix), which also translated into higher within-site β-diversity (Fig. A.4d). A more heterogeneous habitat structure, therefore, can be likely hypothesized as a fundamental driver of the greater species richness recorded at sacred sites.

An overview of habitat compositions can also give some insight into the ecological and religious histories of SNS. It is an ongoing debate, reprised by Salick et al. (2007), whether sacred sites owe their biodiversity rates to particular regimes of human management or to original biological characters, which also contributed to their establishment as worship centres. While an interaction of both factors cannot be excluded, the remarkably higher occurrence of geo-morphological traits such as rock formations, grottos and water sources that we recorded at our study sites (Table A.2 in the Appendix) might at least offer some grounds to support the second hypothesis.

4.1.3 Contribution to landscape-scale diversity

While the plant diversity that we recorded at sacred sites is noticeable but not outstanding, our findings indicate that sacred sites might play an important role for diversity at the landscape-scale, as found by Bhagwat et al. (2005) in agro-forestry matrices in western India. Indeed sacred sites contribute to local species pools a significantly higher number of unique species than control sites. Further, this difference is significant whether it is considered as an absolute count, or standardized by local species richness (Table 1). Also in this case, the occurrence of rarer or more heterogeneous habitat compositions, offering greater niche differentiation, could be at the root of similar diversity patterns. Admittedly, our study was not designed for exhaustively assessing contributions to landscape-scale diversity and the present hypothesis should be empirically tested by further research.

4.1.4 Effect of anthropogenic activity

Sacred sites are cultural areas that have been used for religious purposes for centuries. This inevitably implies anthropogenic activities of some kind. It has been shown that traditional low-intensity interventions, such as selective thinning or collection of understory products, can be beneficial for local diversity (Rescia et al. 1994; Linares et al. 2011), as they favour the creation of micro-habitat mosaics (Selvi and Valleri 2012). This is consistent with the “intermediate disturbance” hypothesis (Grime 1973; Huston 1979), which proposes that species richness is positively influenced by moderate rates of disturbance (Naveh and Whittaker 1980; Vetaas 1997). Dynamics of this kind are likely to characterize the sacred sites in our study and contribute, together with the occurrence of particular geo-morphological features, to their greater diversity.

Our results, however, suggest that anthropogenic practices can translate into higher diversity only as long as they are subjected to informal regulations or codified in sustainable uses and traditions, as it happens at sacred sites. Complete lack of either official or informal management institutions, instead, is likelier to cause species-poor communities. Similarly, we highlight that the benefits are clearer within low or very low limits of anthropogenic disturbance, while decrease for sites yearly visited by thousands of pilgrims (Fig. A.5 in the Appendix). This is an expectable outcome, and in line with issues of overcrowding denounced at other SNS in Western Europe (Mallarach and Papayannis 2010). A competing hypothesis, however, could have been offered by functional and evolutionary theories in social anthropology (Bulbulia and Sosis 2011), which view religion as fostering cooperative behaviour, possibly leading to sounder management of common resources (Sosis and Ruffle 2003). In this case, a positive relation could have been expected between the religious importance of a site and its biodiversity.

4.1.5 Relation with official protected areas

The relation that we found between plant richness and presence of PAs is harder to interpret. Partly it follows basic expectations: the narrower differences in species number between sacred and control sites within PAs are not so surprising, and could be due to more standardized management regimes and disturbance levels inside conservation areas. Similarly, the lower richness found at control sites located outside of PAs, although not statistically significant, is in line with common assumptions. There remains to interpret, however, why sacred sites become species-richer the farther from PAs. A possible explanation in that sense could be that more relaxed regulations away from PA borders may allow traditional anthropogenic activities, such as the collection of heaths or edible plant products, which increase local richness (Selvi and Valleri 2012), as already mentioned above. For example, sites in our study located farther from PAs are also characterized by increasing tree densities but smaller basal areas, which could indicate a greater incidence of coppicing. We suggest, however, that the occurrence of a similar pattern and its possible drivers should be further tested in future studies.

4.2 Influence of other factors on plant diversity

Type of macro habitat and tree density were other significant factors in determining species richness, besides habitat heterogeneity and association with a sacred site. This is largely consistent with other studies and ecological patterns. Grasslands are renowned as the most speciose habitat around the world (Wilson et at. 2012), and also in our case the highest levels of species richness were found at sites characterized by grassland habitats (Fig. 3). Similarly, our results are in line with the findings of Blasi et al. (2004), who pointed at mixed *Quercus* woods as the species-richest types of forest in the Italian peninsula, and Chiarucci et al. (2001), who underlined the low number of species in mountain forests dominated by *Fagus sylvatica*.

Detrimental impacts of tree density and overstory canopy on understory richness, as found in our case (Fig. 4), are also easy to hypothesize. Indeed they have been shown in a number of instances, for example due to decreasing levels in light input (Parker and Muller 1982), although also nursing or facilitation effects favouring understory richness are known (Callaway et al. 1991). Similar results to ours, however, were also reported by Bacaro et al. (2008), who recorded a negative relation between tree stem density and understory richness in six forests across Tuscany.

5. Conclusions

While reviews of PA shortcomings usually focus on the southern hemisphere and biodiversity hotspots in the tropics (Inamdar et al. 1999; Murphree 2009; Mora and Sale 2011), severe limitations are faced also by conservation schemes in Europe (Hirschnitz-Garbers and Stoll-Kleemann 2011) and in the study area. These are due to such diverse causes as poor design of the PA network (Ioja et al. 2010), lack of protection for particular habitats, species and ecological processes (Maiorano et al. 2007; Campedelli et al. 2010), variable consensus and support from local populations (Dimitrakopoulos et al. 2010; Grodzinska-Jurczak and Cent 2011), and contrasting stakes in biodiversity exploitation and land use (Young et al. 2005). It has been suggested that SNS around the world could offer a partial solution to such issues and could be integrated into the existing network of PAs in order to maximize conservation potential (Bhawgat and Rutte 2006; Dudley et al. 2009; Shen et al. 2012).

Our results are of great relevance, as they are among the first to quantitatively prove that traditional management of sacred sites significantly contributes to the conservation of biodiversity, also in western industrialized contexts. They provide, however, only mixed support to the idea of a straightforward incorporation of SNS into state-driven PAs. We point out, in fact, that the ecological benefits of SNS seem more distinct when site management is left to traditional arrangements rather than associated with PA regimes. This specificity of SNS should be kept in mind in the planning process of PAs and possible incorporation of sacred sites into state-driven conservation networks (Wild and McLeod 2008). Moreover, it should be recalled that conservation at sacred sites is more a by-product than an aim in itself (Rutte 2011), as their purpose is primarily a cultural and spiritual one. It would be incorrect, therefore, to see sacred sites as a direct extension of PAs properly speaking, as the goals of the two – and often their areal extent and ecological traits – are inherently different.

SNS, however, can confer a set of benefits of which conservation professionals should be aware. Indeed our findings confirm the notion that SNS display noteworthy biological attributes: in the case of Central Italy, they contribute to increasing heterogeneity and overall species pools in fragmented agricultural landscapes, to conserving patches of old-growth forest, and to maintaining habitats typical to the Mediterranean biome and the Italian eco-region, which are dramatically underrepresented in official PAs (Underwood et al. 2008). Raising awareness on these fundamental ecological characters of SNS would be important as a way to reinforce the support of local religious communities to conservation purposes (Hart 2006), and further strengthen the rising collaboration between Catholicism and environmentalism (Carroll 2001).

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Appendix

Supplementary figures and tables.

Table A.1 - Overview of study sites, including location, name, altitude, inclusion in official PA, habitat type, and synthetic score of religious importance

Code	Region	Location	Name	Altitude	PA	Habitat	Religious importance
A1	Abruzzo-Molise	Balsorano	Grotta Sant'Angelo	923	Y	Quercus ilex-dominated deciduous forest	3
A2	Abruzzo-Molise	Liscia	Grotta di San Michele Arcangelo	432	N	Quercus-dominated deciduous forest	3
A3	Abruzzo-Molise	Castel di Sangro	Santuario Santa Maria dell'Eremita	935	N	Quercus-dominated deciduous forest	2
A4	Abruzzo-Molise	Pescocostanzo	Eremo San Michele	1313	Y	Alpine grassland	1
A5	Abruzzo-Molise	Brecciarola, Serramonacesca	Eremo Sant'Onofrio	659	Y	Mixed eciduous forest	2
A6	Abruzzo-Molise	Assergi, L'Aquila	Sorgente di San Franco	1744	Y	Alpine grassland	2
L1	Lazio	Settefrati	Santuario Madonna del Canneto	1051	Y	Fagus-dominated deciduous forest	4
L2	Lazio	Montefusco, Itri	Santuario Madonna della Civita	646	Y	Quercus ilex-dominated deciduous forest	4
L3	Lazio	Ischia di Castro	Eremo San Colombano	141	Y	Quercus-dominated deciduous forest	1
L4	Lazio	Borgo San Pietro, Petrella Salto	Grotta di Santa Filippa Mareri	1167	N	Quercus-dominated deciduous forest	2
L5	Lazio	Serrone	Eremo di San Michele Arcangelo	1119	Y	Quercus ilex-dominated deciduous forest	2
L6	Lazio	Vallepietra	Santuario della Santissima Trinità	1385	Y	Fagus-dominated deciduous forest	4
M1	Marche	Albacina, Fabriano	Eremo Madonna dell'Acquarella	736	Y	Quercus-dominated deciduous forest	3
M2	Marche	Ambro, Montefortino	Santuario Madonna dell'Ambro	716	Y	Quercus-dominated deciduous forest	4
M3	Marche	Montecopiolo	Eremo Monte Carpegna (Madonna del Faggio)	1262	Y	Fagus-dominated deciduous forest	3
M4	Marche	Esanatoglia	Romita di Monte Gemmo	778	N	Quercus-dominated deciduous forest	1
M5	Marche	Pergola	Santuario Madonna del Sasso	423	N	Quercus ilex-dominated deciduous forest	2
M6	Marche	Pieve Torina	Eremo di Sant'Angelo in Prefoglio (delle Colonne)	641	N	Quercus-dominated deciduous forest	2
T1	Toscana	Caprese Michelangelo	Eremo La Casella	1279	N	Fagus-dominated deciduous forest	2
T2	Toscana	Tre Case, Piancastagnaio	Leccio delle Ripe (di San Francesco)	846	N	Quercus ilex-dominated deciduous forest	2
T3	Toscana	Sasso di Santa Brigida, Pontassieve	Santuario della Madonna delle Grazie al Sasso	580	Y	Mixed deciduous and conifer forest	3
T4	Toscana	Bagni di San Filippo, Castiglione d'Orcia	Grotta di San Filippo Benizi	603	Y	Mixed eciduous forest	2
T5	Toscana	Sorano	Eremo di San Rocco	414	N	Quercus-dominated deciduous forest	1
T6	Toscana	Vagli di Sotto	Eremo di San Viano	1088	Y	Mixed eciduous forest	2
U1	Umbria	Arrone	Santuario di Santa Maria dello Scoglio Rotondo	481	N	Mixed deciduous and conifer forest / mediterranean scrub	3
U2	Umbria	Stroncone	Eremo di San Benedetto in Fundis	644	N	Quercus-dominated deciduous forest / dry grassland	1
U3	Umbria	Scandolaro, Foligno	Eremo di Sant'Angelo in Gruttis / Madonna del Riparo	623	N	Quercus ilex-dominated deciduous forest	2
U4	Umbria	Assisi	Madonna della Speranza ai Tre Fossi	531	Y	Quercus-dominated deciduous forest / dry grassland	3
U5	Umbria	Roccatamburo, Poggiodomo	Eremo della Madonna della Stella	708	Y	Deciduous riparian forest	2
U6	Umbria	Civitella, Baschi	Eremo della Madonna della Pasquarella	204	Y	Quercus ilex-dominated deciduous forest	3

Score of religious importance: (1) Abandoned or nearly abandoned site, with sporadic and mostly irregular visits; (2) Moderately important site, yearly visited by a few hundreds pilgrims; (3) Important site, yearly visited by several thousends pilgrims; (4) Very important site, yearly visited by dozens of thousands pilgrims

Table 2 - Classification of micro-habitat types, and number of occurrences of each type at sacred and control sites

	Type of micro-habitat patch	Number of occurrences at sacred sites	Number of occurrences at control sites
Anthropogenic	Barren / degraded	4	0
	Dirt road / path	22	12
	Paved road / car park / built structure	9	4
	Total occurrences	***35***	***16***
Natural	Broadleaf closed-canopy forest	26	22
	Broadleaf open-canopy forest	2	5
	Cliffs / rock outcrops	22	11
	Dry grassland	7	7
	Grotto	1	0
	Meadow	1	0
	Mediterranean scrub	11	12
	Mixed broad- and needleleaf forest	4	4
	Mountain pasture	2	2
	Mountain scrub	3	2
	Orchard / olive grove / lawn	5	1
	Riparian zone	3	2
	Spring / water course	6	1
	Total occurrences	***93***	***69***

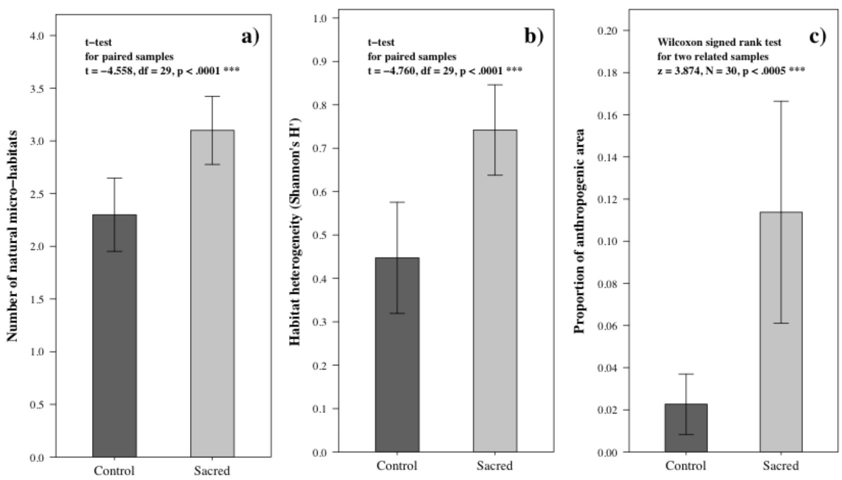

Fig. A.1. Mean number of natural micro-habitat types (a), index of habitat heterogeneity (b), and proportion of anthropogenic area (c) at sacred and control sites. Error bars indicate 95% confidence intervals.

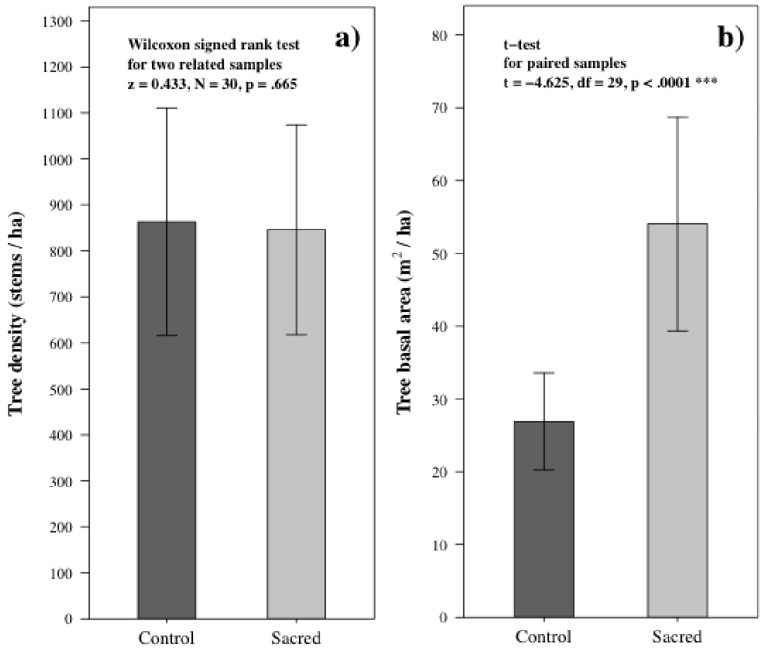

Fig. A.2. Mean tree density (number of stems per hectare) (a), and total basal area (b) for trees ≥ 10 cm DBH at sacred and control sites. Error bars indicate 95% confidence intervals.

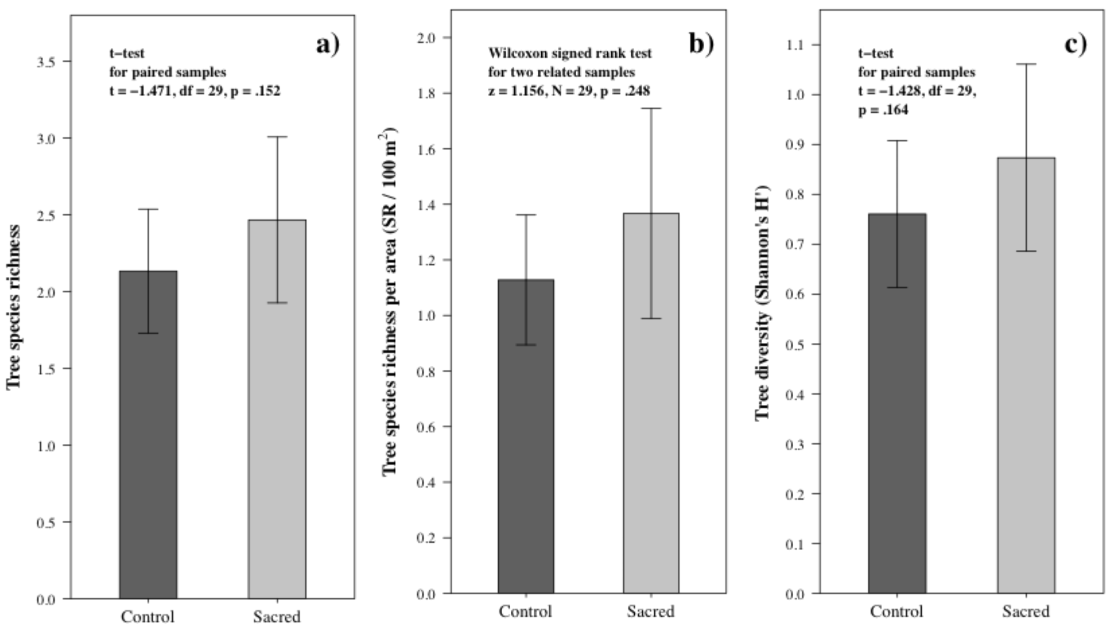

Fig. A.3. Mean number of tree species (a), tree species per 100 m^2 (b), and tree diversity measured by Shannon's H' (c) at sacred and control sites. Error bars indicate 95% confidence intervals.

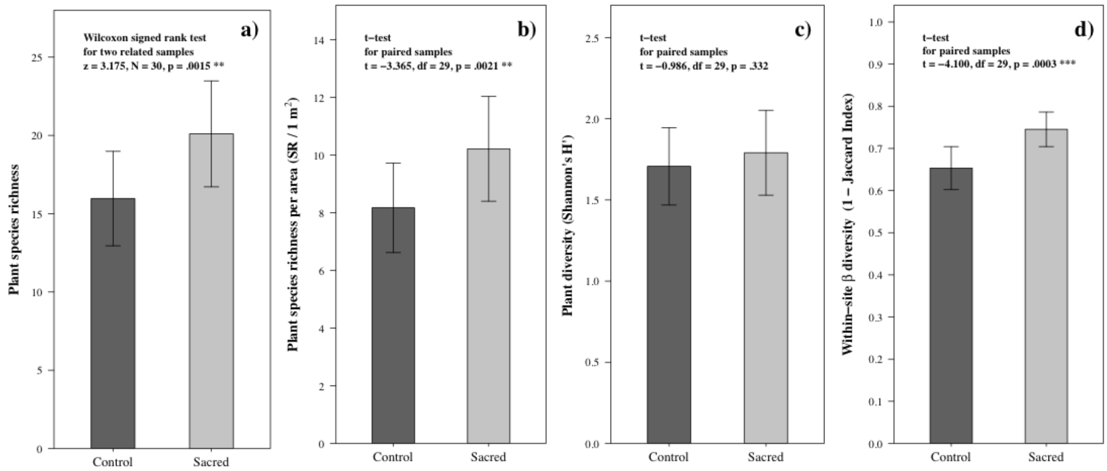

Fig. A.4. Mean number of plant species (a), plant species per 1 m^2 (b), plant diversity measured by Shannon's H' (c), and within-site β-diversity (d) at sacred and control sites. Error bars indicate 95% confidence intervals.

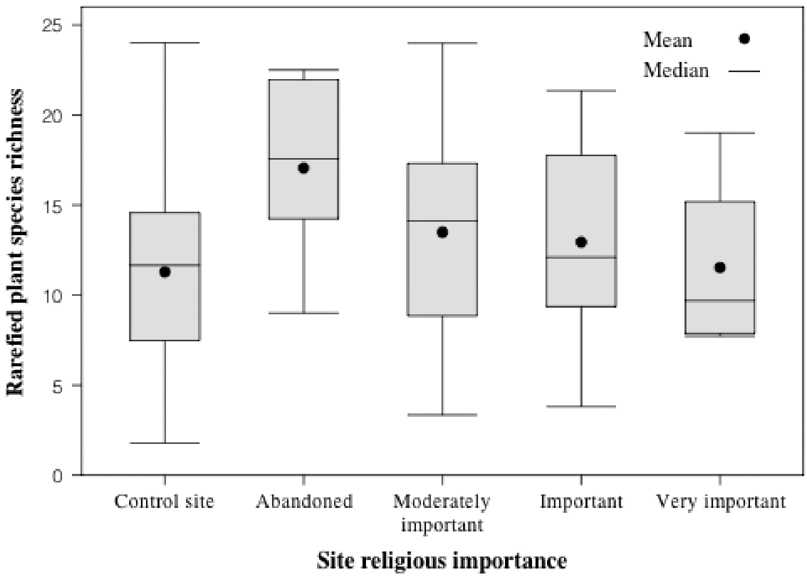

Fig. A.5. Distribution and mean values of plant richness across control sites and sacred sites of different religious importance.

CHAPTER FOUR

Healing animals, feeding souls: ethnobotanical values at sacred sites in Central Italy

To be submitted to *Biodiversity and Conservation*

Detail of the procession held at the Marriage of the Trees in Vetralla, Lazio (top), and *Quercus* acorns in the sacred grove of Monteluco di Spoleto, Umbria (bottom). Photos by Katia Marsh.

Healing animals, feeding souls: ethnobotanical values at sacred sites in Central Italy

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ABSTRACT

Ethnobotanical knowledge is a fundamental repository of the material and intangible values that local people have attributed to elements of biodiversity. This knowledge is often related to spiritual practices and religious sites, where useful plants have been nurtured and conserved. Here, we rely on the available literature and first-hand floristic surveys to examine the occurrence of ethnobotanical values at thirty Catholic shrines in Central Italy, and compare them with an equal number of non-sacred, control sites. We show that sacred and control sites do not significantly differ in number and proportion of useful species, except for animal-related uses, which are more frequent at the sacred sites. In all, useful species diversity is strongly correlated with total species richness, although the concentration of valuable plants declines with altitude, and is highest in deciduous forest habitats. Finally, there are no noticeable micro-spatial patterns in the distribution of valuable plants around the sacred sites, while the distribution of trees varies significantly, as the largest specimens are mainly clustered around shrines. The results suggest that only trees have been selectively managed at sacred sites, probably in virtue of the symbolic and spiritual values that are frequently associated with old-growth forests and giant trees. Also, they underline the importance that forest ecosystems have played for rural livelihoods in the study area: this represents an element of local heritage that should be considered in current and future schemes of forest conservation and management.

1. Introduction

In this study we investigate the occurrence of useful plants at sacred natural sites in Central Italy. Sacred natural sites (henceforth, SNS) have been defined by the International Union for the Conservation of Nature (IUCN) as “areas of land or water having special spiritual significance to peoples and communities” (Wild and McLeod 2008). SNS are deemed to embody a strong connection, expressed in particular cultural practices, between people and environment (Hughes and Chandran 1998).

The pivotal role played by these revered places for the conservation of biocultural diversity (Maffi 2005) has been highlighted over the last years (Pungetti et al. 2012). Both important ecological traits – including endemic, rare, and threatened species – and traditional customs have often found a refuge and space of preservation at sacred sites (Chouin 2002; Fomin 2008; Dudley et al. 2010; Ormsby and Bhagwat 2010). SNS also represent important examples of the application of traditional ecological knowledge (Gadgil et al. 1993; Berkes et al. 2000), and indigenous ethnobiology. Among the biodiversity patterns recorded in sacred groves and other sacred landscapes, high densities of medicinal plants and other useful species are not uncommon (Boraiah et al. 2003; Anderson et al. 2005; Khumbongmyum et al. 2005), confirming that these places have been managed by local communities as repositories of vital resources and knowledge.

The study of SNS and their nexus with biocultural conservation has gained considerable momentum in East Asia and Africa, but remained underexplored in Western non-traditional contexts, although interest has clearly been on the rise (Mallarach and Papayannis 2010). In that perspective, Central Italy has been indicated as an area where a link between ecological values and spiritual heritage is particularly evident, as it both overlaps with a major biodiversity hotspot in the Mediterranean biome (Myers et al. 2000; Olson and Dinerstein 2002), and displays a remarkable wealth of religious heritage and worship sites (De Waal 2010; Cinquepalmi and Pungetti 2012; Frascaroli, in press). Rich ethnobotanical knowledge is also well rooted in the area, and is locally correlated with its high floristic diversity (Idolo et al. 2010). Numerous contributions have documented the wealth of past and present plant uses among the surviving rural populations of the Italian peninsula (Pieroni 2000; Leporatti and Corradi 2001; Uncini Manganelli et al. 2001; Pieroni and Giusti 2000; Pieroni et al. 2004; Guarrera 2005; Ghirardini et al. 2007; Guarrera and Leporatti 2007). Little attention, on the contrary, has been dedicated to the occurrence patterns of useful taxa, and how these might be related to specific cultural traditions. These, however, are fundamental questions in order to steer and inform the conservation of useful plants in front of accruing societal changes, and to better integrate cultural and intangible values of biodiversity into conservation schemes (Vershuuren 2006).

In a previous study, we used floristic surveys to assess diversity rates at thirty SNS in Central Italy, and compare them with an equal number of similar control sites. We found that the sacred sites differ from the control ones with regards to forest structure, habitat composition, and overall species richness, as they hosted a significantly greater number of large trees, habitat fragments, and plant species (Frascaroli et al., in preparation). We concluded that SNS have played a noticeable role for the conservation of certain habitat types, as well as biological diversity within habitats.

Here, we rely on a similar approach and on the available knowledge of ethnobotanical resources in Central Italy, to assess the relevance of SNS for conservation and management at the level of species and individuals. For that purpose, we compare the occurrence of useful taxa between sacred and control sites, and analyze the distribution of valuable plants and giant trees around SNS at a micro-spatial scale. We hypothesize to find a strong link between SNS and use values of biodiversity, as a consequence of selective management and conservation of valuable species. We consider tree sizes in our analyses, as giant tree specimens and tree management practices are frequently associated with belief systems and spirituality worldwide (Turner et al. 2009; Blicharska and Mikusinski 2013), and embody important symbolic values of nature. One of our hypotheses, in fact, is that SNS might have been nurtured and managed as repositories of plants valuable for ritual and symbolic purposes, while more utilitarian values might be more common at non-sacred control sites.

2. Methods

2.1 Study area

2.1.1 Geographical and environmental background

Central Italy consists of five administrative regions: Tuscany, Marche, Umbria, Lazio, and Abruzzi. The surface area, which exceeds 70,000 km^2, spans between 41°13’22.00’’N – 44°28’41.90’’N and 9°41’26.80’’E – 14°46’58.80’’E, and is dominated by hills (62.4%) and mountains (34.2%), whereas plains are limited to the coastline and valley-bottoms (3.3%). The elevations are part of the Apennines and pre-Apennines. The highest peak is Corno Grande (2,912m ASL) in Abruzzi, but other reliefs above 2,000m ASL are scattered across the region, including the Majella massif in Abruzzi, Mounts Simbruini between Abruzzi and Lazio, Mounts Reatini in Lazio, and Mounts Sibillini between Marche and Umbria.

Despite the considerable anthropogenic impacts that have mainly affected the lowland areas, in all the flora remains characterized by high diversity, with above 3,000 taxa of vascular plants being reported for each of Abruzzi, Lazio, and Tuscany, and more than 2,300 for each of the other regions (Conti et al. 2007). Typical biomes in the area include: Mediterranean scrub along the coasts; Italian sclerophyllus and semi-deciduous forest (Olson and Dinerstein 2002) with *Quercus ilex*, *Quercus pubescens*, *Quercus cerris*, *Ostrya carpinifolia*, and *Fraxinus ornus* in sub-mountainous areas; and Apennine montane forest above 1,000m ASL, with *Fagus sylvatica*, *Acer opalus*, and occasional relict stands of *Abies alba*.

This floristic wealth is mirrored by a high number of known ethnobotanical uses (Guarrera 2005), and a large proportion of protected land. Almost one quarter of the total land surface is formally part of some official protected area (PA). National Parks are the oldest conservation scheme in modern Italy (Sievert 2000) and cover 5% ca. of the region. The Park of Abruzzi, Lazio and Molise, established in 1923, is the oldest park in the area and one of the oldest in all of Europe (Pratesi and Tassi 1998). Other National Parks include the parks of Gran Sasso, Majella, Monti Sibillini, and Foreste Casentinesi. An additional 7% ca. of protected land is accounted for by regional parks and other state-driven reserves, while the remaining portion (11% ca.) is constituted by areas recently incorporated into the Natura 2000 network (EU 1992), or regulated by international agreements such as the Ramsar Convention.

2.1.2 Religious and cultural background

Religious heritage and traditions are also very rich in the area, and retain a tight bond with the world of nature, in spite of the massive social changes and abandonment of rural spaces that have occurred over the last decades (Antinori 2009; Blondel et al. 2010). An association with natural landscapes, such as forests, water springs, and high places, is frequently found among monastic settlements and Catholic worship sites (Frascaroli, in press; and also Nolan and Nolan 1989). The mingling of the dominant Catholic faith with local folk beliefs is also common in the form of syncretic spiritualities: natural elements are often regarded and invoked as sacred, and also the ritual and therapeutic use of rock, water, and plants, although dwindling, remains fairly common (Micati 2007; De Waal 2012).

In this religious context, several authors have also highlighted the prominent connection between sacred places and the movement of people and animals. Transhumance has been practiced in the Mediterranean for 3,000 years (Blondel et al. 2010) and a number of shrines and hermitages are thought to have risen along the ancient routes used by transhumant herders and their animals, most often sheep (De Waal 2010; and also Pellegrini 1984). Also the cult of St Michael the Archangel, one of the most rooted and heartfelt popular devotions in the study area, is explicitly linked to the traditions of transhumance and animal herding: for example, the celebrations for the Angel fall on May 8th and September 29th, which respectively coincided with the dates when the herds set off for the mountain pastures, and returned to the plains (Marucci 2003).

2.2 Sampling protocol and data collection

Fieldwork was conducted in 2010-2011 at a sample of thirty shrines that were selected so as to: be evenly distributed across the study area; be located as equally as possible within and outside official PAs; be representative of different habitat types; and be characterized by different levels of religious importance (see also Frascaroli et al., in preparation). Each shrine was then paired with a non-sacred control site located nearby (≈ 1 km), having analogous elevation (mean ± SE of altitudinal difference: 54.7 ± 8.3 m), aspect, and habit type.

Trees were sampled using 100 m^2 (25 m x 4 m) transects starting at the border of each shrine and stretching 25 m away from it. One to three transects were laid at each site, according to the natural limitations encountered (e.g., presence of cliffs). Species, size (DBH), and distance from shrine border were recorded for all mature tree specimens (i.e., ≥ 10 cm DBH) rooted within each transect.

Within each transect, we nested three 1 m^2 square plots (one at each end, and one in the middle), which were used to sample understory vegetation. We collected specimen vouchers of all vascular plants inside the subplots, including herb and shrub layers, and canopy projections, and estimated their percentage cover. The collected sample were dried for later identification, and deposited at the Herbarium of the Botanical Garden of the University of Zurich. We replicated the sampling scheme and number of transects and subplots at each pair of sacred and control sites.

Successively, ethnobotanical uses were associated with each identified taxon at each site, based on the exhaustive synthesis of the existing literature presented in Guarrera (2006).

Only the uses pertaining to the specific regional context where the specimens had been collected were recorded. The uses were divided in five use categories: (1) animal-related (ANI), including all plants used either as animal fodder or for veterinary purposes; (2) domestic (DOM), including resources used for arts, crafts, and construction; (3) human food (HUF), including all edible plants used in human alimentation; (4) human medicine (HUM), including plants with medicinal, toxicological, and anti-parasitical applications; and (5) information (INF), including the plants used for playing, featuring in mottos or beliefs, or employed in religious and ritual activities, largely coinciding with the definitions of information services (de Groot et al. 2002) or cultural services (MEA 2005).

2.3 Data analysis

To assess the difference between sacred and control sites, and test the hypothesis that useful plants, especially with information values, are more common at sacred sites, we established paired comparisons between matching sites. We used paired t-tests for normally distributed and equal variance data, and Wilcoxon sign-rank tests for two related samples if the data had non-parametric distributions. To account for the influence of total species richness on the numbers of use categories, we divided the numbers of useful species in each use category by the numbers of all available species at each site, and based an additional comparison on those figures.

To assess the strength of the relationship between species richness and occurrence of useful plants, and test what other environmental variables (altitude, habitat type), anthropogenic variables (site religious importance, presence of PA), and external factors (geographic location) influenced the occurrence of ethnoflora, we fitted a linear model to the data, having confirmed the assumptions on normality and equal variance of the data.

Finally, to further test the presence of selective management of plant taxa and individual specimens at sacred sites, we analyzed the occurrence of ethnoflora and tree sizes at different distances from each shrine. We used Kruskal-Wallis analysis of variance (ANOVA) by ranks for testing the former, and a simple linear regression for the latter analysis.

All statistical analyses were performed with the software R version 2.15.2 (R Core Team 2012).

3. Results

3.1 Number of useful species and botanical families

We compiled an inventory of 119 plant taxa that were associated with some use value, out of a total pool of 351 species that had been sampled in the study area. The most frequent use category across all sites was HUM-human medicine (430), followed by DOM-craft and domestic uses (207), ANI-animal veterinary and feeding (184), HUF-human food (157), and INF-information values (93).

3.1.1 Useful taxa

Ligneous plants appeared prominently as useful taxa. *Fraxinus ornus* was the species with most associations to use categories across the study sites, and accounted alone for over 9% of all occurrences in the inventory (Fig. 1). Eleven more species totalled over 2% of citations each, including other four deciduous trees, i.e., *Quercus pubescens*, *Cornus mas*, *Ostrya carpinifolia*, and *Quercus ilex*, and one shrub species, i.e., *Juniperus communis*.

Fraxinus ornus was used in all the study regions both as a medicinal plant (for its diuretic properties; Guarrera 2006) and for animal veterinary (either as a laxative or to treat particular disturbances in hens; De Capite and Menghini 1973, Bellomaria 1982, Guarrera 1994, Camagni and Uncini Manganelli 1999, Pieroni 2000, Guarrera et al. 2005). Other pathologies treated with *Fraxinus ornus* locally included arthrosis, rheumatisms, cough, fever, haemorrhage, and wounds (Pagni and Corsi 1979; Bellomaria and Della Mora 1985;

Guarrera 1987, 1994). In some areas, *Fraxinus ornus* was also employed for the weaving of baskets, carving of shepherd staffs, and green dyeing (Guarrera 1987, 1994).

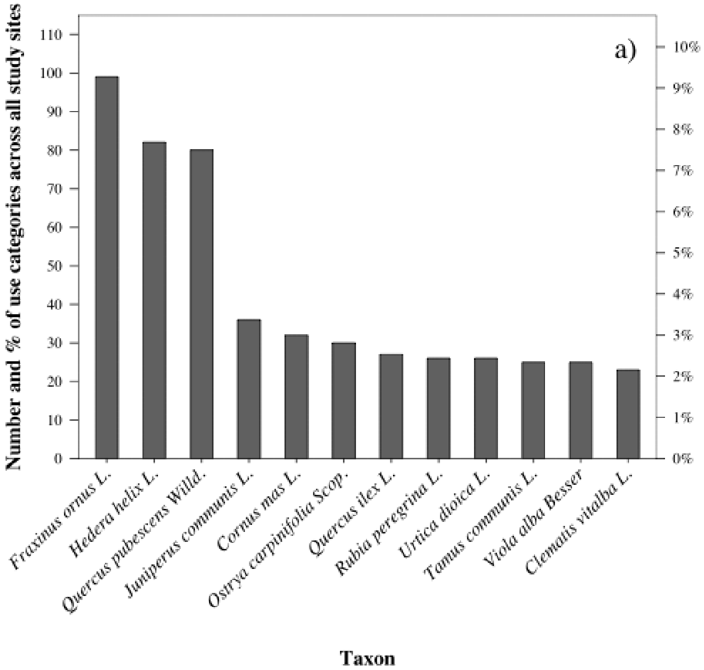

Fig. 1. Number of use categories associated with different taxa across all study sites and relative percentage of all use categories recorded. Only taxa > 2% are illustrated.

Of the other tree species associated with several use categories, also *Quercus pubescens* and *Corylus avellana* were often indicated as useful for curing human pathologies. The medical uses of the former were diverse, including the treatment of sore throat, respiratory disorders, contusions, skin and gums infections (Corsi and Pagni 1978; Pagni and Corsi 1979; Tammaro 1984; Leporatti et al. 1985; De Simoni and Guarrera 1994; Guarrera 1994; Leporatti and Corradi 2001), as well as the prevention of dental cavities (Guarrera 1981, 1984). Further, *Quercus pubescens* was extensively employed for crafts and domestic uses, the feeding to pork, sheep, and rabbits, as well as a ritual protection against witches and evil eye (Guarrera 1981, 1987, 1994; Tammaro 1984; De Simoni and Guarrera 1994; Manzi 2003; Guarrera et al. 2005). The use of *Corylus avellana*, instead, was mostly indicated in relation to breathing and circulation disorders (Leporatti et al. 1985, 2001; Guarrera 1994; Maccioni et al. 1997). The other tree species, *Ostrya carpinifolia* and *Quercus ilex*, finally, were more commonly used for domestic purposes, such as the crafting of ploughs or handles for different tools, and in the case of the acorns of *Q. ilex* the feeding of animals (Guarrera 1981; De Simoni and Guarrera 1994; Guarrera 1994; Guarrera et al. 2004).

3.1.2 Distribution of useful taxa across botanical families

Thirty-nine botanical families were represented in the inventory of useful taxa, against 55 families that appeared in the broader pool of all sampled species. Of those 44, however, just 13 families included 65% of all useful taxa. Roasaceae was the most numerous family, contributing above 12% of all useful species, followed by Asteraceae, Fabaceae, and Lamiaceae (Fig. 2). The distribution of species across families was not constant, whether one considered all taxa or only useful ones, and the correlation between number of available species and number of useful species in each family, although significant, explained only 21% of the total deviance in the distribution (quasi-Poisson GLM, $F = 14.15$, $p < .001$). Species-rich families, such as Asteraceae or Fabaceae, did not result into equal proportions of useful plants, whereas Rosaceae, Ranunculaceae, Fagaceae, Violaceae, Urticaceae, Oleaceae, and Primulaceae contributed considerably more to the pool of useful taxa than overall species richness.

Most frequently, the plants in these last-mentioned families were categorized as useful in virtue of one or more medicinal applications. Other use categories, however, were also prominent for specific families. Rosaceae, for example, included a number of plants that are edible or used in the preparation of liquors and conserves, such as *Crataegus monogyna*, *Prunus spinosa, Rosa arvensis*, *Rosa canina*, and *Sorbus aria* (Corsi and Pagni 1979; Guarrera 1981, 1987, 1994; Pezzotta 1994; Leporatti et al. 2001). Similarly, Ranunculaceae (*Clematis vitalba* and *Helleborus spp.*), Urticaceae (*Urtica dioica* and *Parietaria officinalis*), and Oleaceae (*Fraxinus spp.*) were popular for veterinary use (De Capite and Menghini 1973; Guarrera 1981; Tammaro 1984; Pieroni 2000; Tomei et al. 2001; Guarrera et al. 2005).

Finally, tree species in the family Fagaceae were associated with numerous applications in each use category. The wood, leaves, and roots of these plants are often indicated as important raw materials for building and domestic uses, but also symbolic and cultural values of *Fagus sylvatica* and different species of *Quercus* are reported for nearly all of the study area (Guarrera 1981, 1994; Tomei et al. 2000; Manzi 2003).

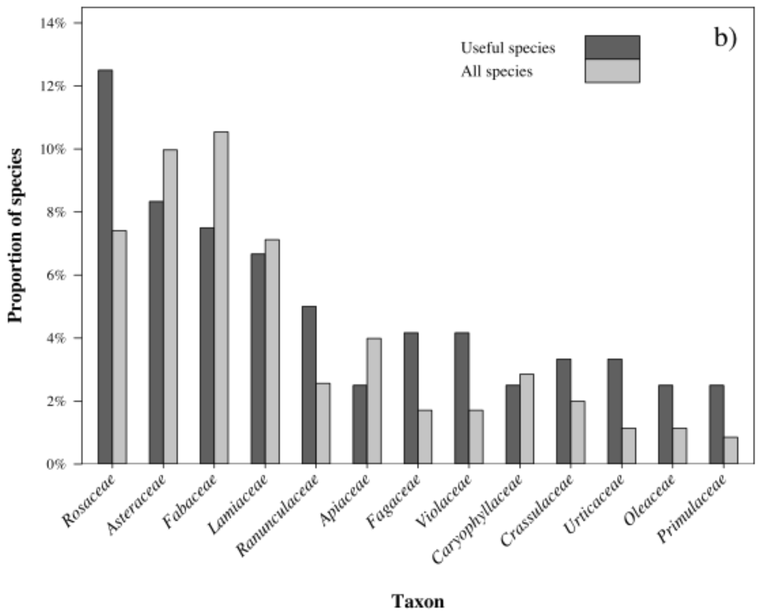

Fig. 2. Contribution of different botanical families to total species richness and useful species diversity. Only families > 2% are illustrated.

3.2 *Comparison of sacred and control sites*

In general, a significantly higher number of useful taxa were recorded at sacred than control plots (mean ± SE: 9.3 ± .7 versus 8 ± .6; $t = -2.5143$, $df = 29$, $p < .05$). More specifically, sacred sites hosted more plants used for medicinal applications (mean ± SE: 7.7 ± .7 versus 6.6 ± .6; $t = -2.2468$, $df = 29$, $p < .05$) and animal veterinary and feeding (mean ± SE: 3.5 ± .4 versus 2.6 ± .3; $t = -2.9044$, $df = 29$, $p < .05$), while the mean differences for other use categories were not significant (Fig. 3a). Control sites, however, displayed a higher proportion of useful taxa out of site species richness, both in overall (mean ± SE: .55 ± .03 versus .49 ± .3; $t = 1.5638$, $df = 29$, p .129), and for each use category except for animal veterinary and feeding (Fig. 3b), although none of these differences were statistically significant.

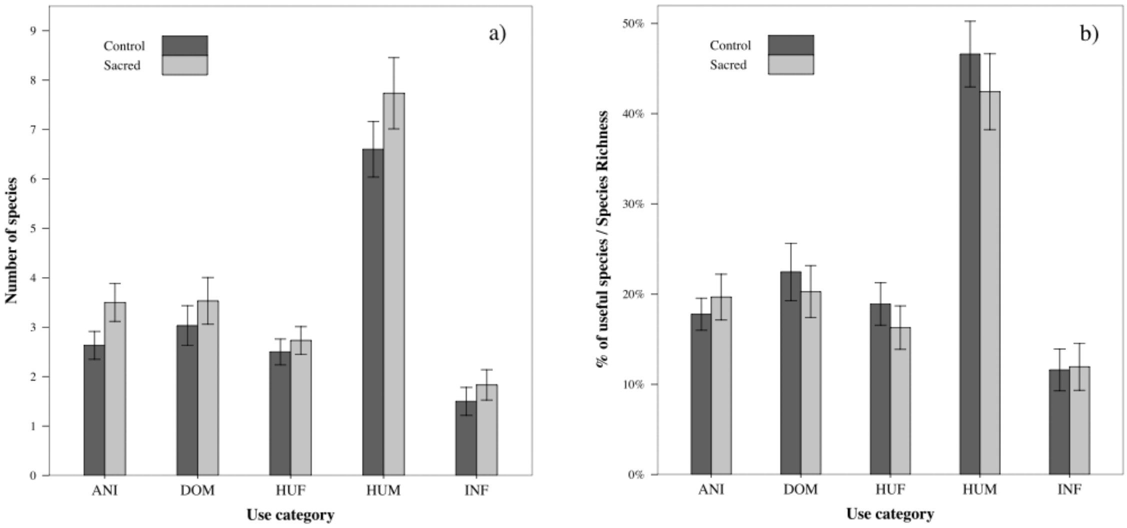

Fig. 3. Mean number of useful taxa in each use category (a), and mean percentage of useful taxa out of total species richness in each use category (b) at sacred and control sites. Error bars indicate standard error of the mean. (HUM: human medicine; DOM: craft and domestic uses; ANI: animal veterinary and feeding; HUF: human food; INF: information values)

3.3 Influence of plant diversity, habitat, altitude, geography, and cultural factors on useful taxa

There was an evident correlation between species richness and the number of useful taxa recorded at each site. This relation alone accounted for over 60% of the total variability in the number of useful plants ($p < .005$, Table 1). Increasing altitude affected negatively the occurrence of useful taxa ($p < .001$), whereas the relationship of total species richness with elevation had an opposite sign. Also, useful plants diversity varied significantly in relation to habitat type ($p < .01$): after standardizing by species richness, deciduous forest assemblages showed the highest concentrations of useful taxa (mean ± SE: from .603 ± .03 for *Quercus ilex*-dominated forests to .475 ± .02 for mixed deciduous forests; Fig. 4), while the ratio between useful taxa and species richness was generally lower for grassland habitats. Finally, there were significant differences across study regions ($p < .05$), while no anthropogenic factors (including official protection, presence of a shrine, and religious importance of the site) significantly affected the distribution of useful taxa.

Table 1 - Summary table of sequential sum of squares ANOVA, testing the influence of overall species richness, and anthropogenic and environmental variables on the occurrence of useful plants

Explanatory variable	df	SS	F	p
Species richness	1	468.93	169.97	< 0.005 *
Site type (sacred vs. control)	1	0.02	0.006	0.941
Religious importance	1	0.51	0.184	0.672
PA	1	0.91	0.329	0.572
Altitude	1	41.22	14.940	< 0.001 *
Habitat type	6	68.38	4.131	< 0.01 *
Region	4	34.27	3.106	< 0.05 *
Location	21	87.07	1.500	0.175
Site type : PA	1	3.33	1.206	0.284
Residuals	22	60.7		

Modelling the data having as response variable the number of uses instead of the number of useful species at each site, yielded rather similar results. Only the correlation with total species richness was not as strong (R^2 = .18, p < .001), and there was no significant relation with altitude.

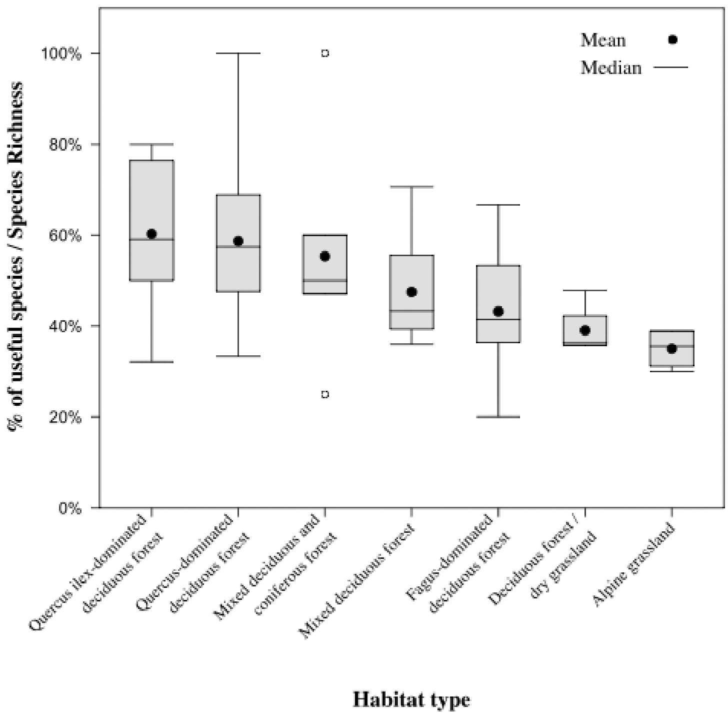

Fig. 4. Distribution and mean values of useful plant diversity divided by total species richness for different habitat types.

3.4 *Influence of distance from shrine on the occurrence of useful plants and tree size*

There were no significant differences in the number of species sampled at different distances from shrines (Kruskal-Wallis ANOVA by ranks: χ^2 = 1.284, *df* = 2, *p* = 0.526), although plots located 12.5m and 25m away from the sacred sites hosted slightly greater diversity than the plots adjacent to the shrines (Table 2).

Table 2 - Number of plants in each use category and number of all sampled species at different distances from shrines, and results of Kruskal-Wallis ANOVA for the distribution of each row in the table

Use category	Distance from shrine (m) 0	12.5	25	χ^2	p
Animal-related	77	75	70	0.461	0.794
Domestic, crafts	80	95	84	0.484	0.785
Human food	55	51	42	1.338	0.512
Human medicine	153	167	159	0.314	0.855
Information	29	44	42	1.823	0.402
Total	394	432	397	1.426	0.490
All sampled species	*366*	*395*	*401*	*1.284*	*0.526*

(*) Significant variables (p ≤ 0.05)

Very similar amounts of useful plants in each use category were also found at different sampling distances, while in all a greater number of use values occurred in sampling plots located at 12.5m from the shrines. Also in this case, however, the Kruskal-Wallis ANOVA yielded non-significant results (χ^2 = 1.426, *df* = 2, *p* = 0.49). On the contrary, tree size was significantly correlated with distance from shrines (*p* < .001, R^2 = 0.096; Fig. 5), with the largest specimens being located closer to the sacred sites.

4. Discussion

4.1 *Distribution of useful species across sacred and control sites*

SNS are considered to be bastions of biocultural diversity (Vershuuren et al. 2010; Pungetti et al. 2012), where the survivals of cultural and spiritual practices and of high biodiversity are interrelated and mutually dependent (Cocks 2006). Research has also shown an important link between sacred places and traditional ecological knowledge, as SNS have been key in conserving important ethnobotanical resources in different parts of the world (Lebbie and Guries 1995; Mesfin et al. 2009). Our analyses, however, did not provide sufficient support to the question as to whether selective management of useful species has occurred at SNS in Central Italy.

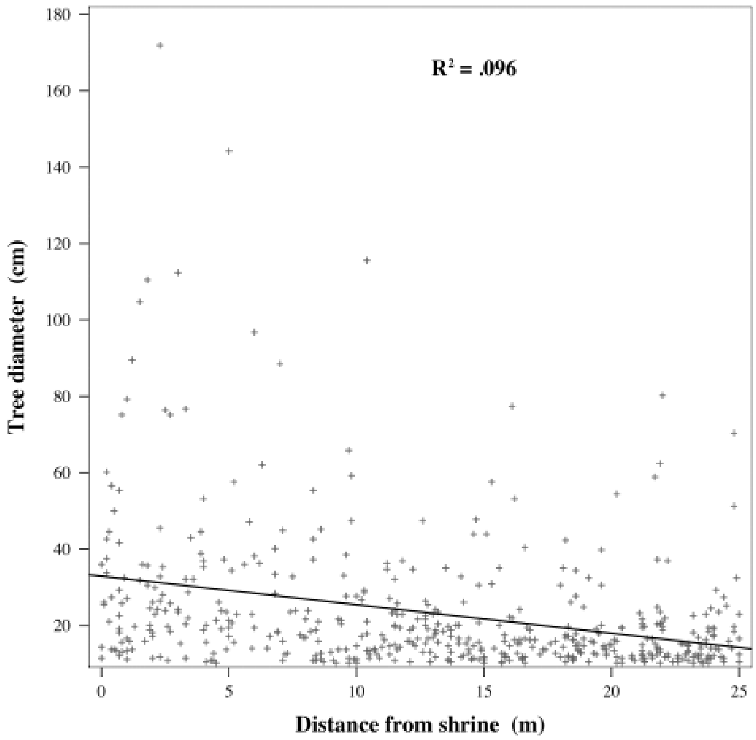

Fig. 5. Linear regression of tree size by distance from shrine for thirty sacred natural sites in the study area.

While useful taxa were more numerous at sacred than control sites, this difference is clearly related to the higher species richness originally recorded at sacred sites (see also ANOVA results in Table 2). Indeed in an earlier study, we found that SNS are significantly species-richer than similar control sites, and that this difference is likely due to both a more complex habitat structure, and to low-intensity forms of anthropogenic activity, which support diversity through the creation and maintenance of micro-habitat heterogeneity (Frascaroli et al., in preparation). The present results suggest that contrarily to what has been observed at SNS in other parts of the world and to our initial hypotheses, these forms of low-intensity management have not significantly conserved or maximized the presence of useful species around SNS in Central Italy up to the present.

Some additional insight can be derived from the comparison of sacred and control sites at the level of use categories. Indeed plants used for animal-related applications were the only use category found to be more numerous at sacred than control sites both as an absolute count and a proportion of all available species, although only the first was statistically significant (Fig. 2a-b). A systematic association of sacred sites with traditional veterinary practice was not initially hypothesized but would be not overly surprising, and could be explained on the grounds of the historical origins of many SNS in the area.

The link between transhumance and SNS is well known in Central Italy, and often celebrated in the devotion to St Michael (Marucci 2003; De Waal 2010). Also in our sample, out of 30 sites, at least 10 show evident traces of the cult of St Michael or transhumant and pastoral traditions: these take as different forms as an evident dedication to the Archangel; the celebration of religious rituals that entail cattle fairs and the blessing of animals, or fall on key dates for the practice of transhumance; and being located along transhumance routes with the historical function of resting posts. The significant concentration of plants used for veterinary applications at SNS, therefore, could be linked to this ancient connection with animal herding, and possibly to the need to tend the animals during long migrations and periods away from homes and villages. The influence of transhumance on ethnobotanical uses and patterns is not wholly unusual and has been reported for other parts of the world (Ladio and Lozada 2004a, 2004b). Future research should aim to confirm and deepen these early assumptions, both from the point of view of ethnography, through interviews with the few enduring communities of traditional herders, and historical ecology, through the analysis of botanical patterns along the ancient routes of transhumance.

4.2 Influence of species richness, altitude, habitat and other factors on the number of useful plant species

As already highlighted, the number of both useful species and use categories was strongly correlated with species richness at the sites, although the second relation was less intense than the first. The existence of a direct link between useful plants and biodiversity is well known (Begossi 1996; Bernstein et al. 1997), although not necessarily linear (Sheil and Salim 2012). While variety might be just one component in the generation of value, this nexus clearly underlines the fundamental importance of biological diversity in sustaining human life and needs (MEA 2005).

Altitude and habitat type were the other two ecological variables that correlated significantly with useful plants diversity. The relation with altitude is interesting, as it superseded the fundamental ecological determinant represented by species richness. Indeed useful plants clearly declined even though total species richness became greater at higher elevations. A similar relation with altitude does not occur in other contexts, where either the number of useful species does not decrease with elevation, or such a decline is motivated by lower levels of total species richness (Salick et al. 1999; Santos et al. 2008). An explanation of this relationship could be familiarity. Other studies, in fact, have stressed a link between plant “apparency” and usefulness (Paiva de Lucena et al. 2007), and the importance of proximity on the collection of useful plants (Weckerle et al. 2006). Similar considerations might suggest that plant species located in more accessible habitats or not too far from human settlements are likelier to have been recognized as useful, and therefore useful plant species result more numerous at low or mid elevations (that is, below 1,000m ASL), in spite of a general increase in floristic diversity at higher altitudes.

The correlation of useful plants diversity with species richness varied significantly also across habitat types. While deciduous forests are generally species-poorer habitats than open-range grasslands, they showed a higher occurrence of useful taxa relative to the number of available species. A comparable element of non-linearity in the relation between species richness and useful plant diversity was also visible within individual botanical families, as the occurrence of useful taxa within families did not strictly mirror their overall diversity. These patterns corroborate the insight that human communities have often focused on particular qualities of habitats and natural resources, and diversity *per se* is not the only predictor of usefulness (Lira et al. 2009). Similarly, they highlight the fundamental importance played by *Quercus*-dominated woodlands and other forest assemblages for traditional livelihoods in the study region. Deciduous forests are one of the endemic habitats that ecologically characterize the Mediterranean biome (Olson and Dinerstein 2002). The co-evolution of deciduous forest habitats and human cultures in the Mediterranean is well-documented, and landscape patterns of Mediterranean forests are the outcome of a long – but far from harmonious – history of environmental as well as anthropogenic influences (Naveh 1987; Blondel et al. 2010). Mediterranean forests are scarcely productive for what concerns wood mass (Llédo et al. 1992), but stand out compared to central- and north-European forests for the wide and diverse range of non-timber products and values that they provide (Blondel et al. 2010). This is clearly reflected in the high proportion of useful species that we found in forest habitats, and in the many and diverse use values associated with deciduous trees such as *Fraxinus ornus*, *Quercus pubescens*, *Quercus ilex*, *Corylus avellana*, and *Ostrya carpinifolia* throughout all of the study area.

Regional variations in the diversity of useful plants, finally, although significant, were likely due to inherent limitations in the data collection methods, than to actual geographical patterns. Indeed the source coverage, synthesized in Guarrera 2006, was uneven for the five regions of the study area: disparities in the presence and number of use reports for the same taxon are likely to be the outcome of this unbalance, and do not necessarily mirror real regional differences. While this does not undermine the reliability of our other findings, a different data-collection protocol should be followed for regional comparisons of plant uses to be meaningful.

4.3 *Distribution of useful plants and giant trees around shrines*

No patterns emerged in micro-spatial distributions, which suggested that useful plants have been selectively nurtured and managed in the immediate surroundings of shrines. There were indications, however, that total species richness is lowest closer to shrines, probably as a consequence of more intense trampling and anthropogenic disturbances in the periphery of sacred sites, although also this datum was not statistically significant.

The absence of spatial patterns in the distribution of useful species is partly surprising, as the occurrence of edible and symbolically important plants is often indicated in the close vicinity of sacred sites (personal observation of information panels at SNS, 2010-2011), and interpreted as historical ecological traces left by dwelling hermits. Together with the comparison between sacred and non-sacred plots discussed above, this result reinforces the conclusion that SNS in the area have not fulfilled the function of “gardens” of useful species for local communities. A competing explanation which, however, cannot be verified on the grounds of the present data, would be that the importance of a similar function might simply have waned over the last decades, as a consequence of rural abandonment and loss of traditional knowledge in the whole Mediterranean basin (De Aranzabal et al. 2008; Petanidou et al. 2008; Idolo et al. 2010). During this time, sacred sites would have kept their role of spiritual centres, but lost relevance as repositories of ethnobotanical resources, leading to progressive homologation with the surrounding vegetation.

The picture changes substantially as tree sizes are considered. We found 17 trees with a diameter greater than 70cm around all SNS. Given their size, these plants rival others that are considered “patriarchal” or “monumental” trees in the respective regions, although they do not always appear in official forestry inventories of giant tree specimens (CFS 2013). Of the trees in question, only five are located farther than 5m away from the shrine's borders, highlighting a significant relation between tree size and vicinity to sacred sites.

The fascination with old-growth forests and monumental trees is an established phenomenon that transcends cultural barriers, and often entails religious, spiritual, symbolic, and aesthetic values (Blicharska and Mikusiński 2013). Trees of various species (but frequently *Fagus sylvatica* and *Quercus spp.*) are indicated as the loci of divine apparitions also in the foundation story of numerous SNS of the study area (Salvatore 2002; CSC 2013), and in at least two sites in our sample. Our empirical findings confirm similar insights, as they suggest that individual tree specimens around sacred sites have been managed and conserved as sources of important symbolic and spiritual values (Turner et al. 2009), or because the very act of conserving them untouched is an important expression of the veneration for the sanctity of the place. In this sense, therefore, SNS were explicitly associated with management practices aimed at maximizing specific values of biodiversity, but the values in question are mainly intangible rather than material or utilitarian, and seem related to other attributes (size, age) than species. The cultural significance of extra-taxonomic traits (see also Pieroni 2001; and Reyes García et al. 2006) should be an important avenue for future research in ethnobiology and the symbolic links between people and biodiversity.

5. Conclusions

At the habitat level, SNS in Central Italy represent important patches of biodiversity. This, however, does not seem to have translated into active forms of management aimed at favouring the occurrence of particularly valuable species. Nonetheless, the conservation of ancient trees has been evident in the immediate proximity of sacred sites, and was probably motivated by aesthetic and spiritual gratifications, which giant trees are known to provide (Moore 2007). These elements suggest the prominence of a conservation attitude based more on the static preservation of outstanding individuals and visual patterns, than on dynamic ecological processes of growth and selection (see also Nabhan 1993). Also, they highlight the symbolic relevance of biodiversity traits beyond variety and taxonomic quality alone: it would be desirable that increasingly more of these elements were considered in ethnobotanical research, as they contribute to highlighting the cultural production of values *within* and not only *across* species.

Broadening the scope, our results also emphasized the primary role played by Mediterranean deciduous forests, as a source of both material livelihoods and information services. The remarkable body of traditional forest knowledge, practices, and beliefs, into which this has translated, represents a rich heritage that is threatened by the dramatic social changes and establishment of industrial forestry during the last century (Parrotta and Agnoletti 2007). Preservation of this heritage should represent an ecological and cultural priority in the study area: the survival both of distinctive cultural landscapes, and of the habitat diversity that is associated with them, ultimately depends upon it (Schmitz et al. 2012; Otero et al. 2013).

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Appendix

Table A.1 - List of the ethnoflora sampled at the study sites, and use categories associated to each taxon. ANI: animal-related uses; DOM: domestic uses and crafts; HUF: human food; HUM: human medicine; INF: information values

Family	Species	ANI	DOM	HUF	HUM	INF
Aceraceae	*Acer campestre L.*	N	Y	Y	Y	Y
	Acer monspessulanum L.	N	Y	N	N	N
Adiantaceae	*Adiantum capillus-veneris L.*	Y	N	N	Y	N
Anacaridiaceae	*Pistacia lentiscus L.*	Y	Y	N	Y	N
Apiaceae	*Angelica sylvestris L.*	N	N	N	Y	N
	Daucus carota (L.) L.	N	N	N	Y	N
	Satureja hortensis L.	N	N	Y	Y	N
Araliaceae	*Hedera helix L.*	Y	Y	N	Y	Y
Asteraceae	*Achillea millefolium L. S.L.*	N	N	Y	Y	N
	Anthemis tinctoria L.	N	Y	N	Y	N
	Arctium lappa L.	N	N	N	Y	N
	Cardus nutans L.	N	N	N	Y	N
	Carlina acaulis L.	N	N	Y	N	N
	Carlina corymbosa L.	N	N	Y	N	N
	Cichorium intybus L.	N	N	Y	Y	N
	Helichrysum italicum (Roth) Don	Y	N	N	Y	N
	Picris hieracioides L.	N	N	Y	N	N
	Solidago virgaurea L.	N	N	N	Y	N
	Taraxacum officinale Weber	N	Y	Y	Y	Y
	Buglossoides purpurocerulea (L.) Johnston	N	N	N	Y	N
Campanulaceae	*Campanula rapunculoides L.*	N	N	Y	N	N
	Lonicera xylosteum L.	N	Y	N	N	N
	Sanguisorba minor Scop.	Y	N	N	Y	N
Caryophyllaceae	*Dianthus sylvestris Wulfen*	N	N	N	N	Y
	Silene italica L.	Y	N	N	Y	N
	Silene vulgaris (Moench) Garcke s.l.	N	N	N	Y	Y
Celastraceae	*Euonymus europaeus L.*	N	N	N	Y	N
Convulvulaceae	*Convolvolus arvensis L.*	Y	N	N	Y	N
	Cuscuta epithymum (L.) L.	N	N	N	Y	N
Cornaceae	*Cornus mas L.*	N	N	Y	Y	Y
	Cornus sanguinea L.	N	Y	N	N	N
Corylaceae	*Corylus avellana L.*	Y	Y	Y	Y	Y
	Ostrya carpinifolia Scop.	Y	Y	N	Y	N
Crassulaceae	*Sedum L. species*	N	N	N	Y	N

	Sedum reflexum L. S.L.	N	N	N	Y	N
	Sedum rupestre L.	N	N	N	Y	N
	Sedum sexangulare L.	N	N	N	Y	N
Cupressaceae	*Juniperus communis L.*	Y	Y	Y	Y	Y
	Juniperus oxycedrus L.	Y	N	N	Y	N
Dioscoreaceae	*Tamus communis L.*	Y	N	Y	Y	N
Ericacea	*Erica arborea L.*	N	Y	N	Y	N
Euphorbiaceae	*Euphorbia cyparissias L.*	N	N	N	Y	N
Fabaceae	*Colutea arborescens L.*	N	N	N	Y	Y
	Coronilla emerus L.	N	Y	N	N	N
	Cytisus scoparius (L.) Link	N	Y	N	Y	N
	Lotus corniculatus L. S.L.	Y	N	N	N	N
	Medicago sativa L.	Y	N	N	N	N
	Onobrychis viciifolia Scop.	N	N	N	Y	N
	Ononis spinosa L.	N	N	N	Y	N
	Robinia pseudoacacia L.	Y	Y	N	Y	Y
	Trifolium pratense L.	N	N	N	Y	N
Fagaceae	*Castanea sativa*	Y	Y	Y	Y	N
	Fagus sylvatica	Y	Y	N	Y	Y
	Quercus cerris L.	Y	Y	Y	N	Y
	Quercus ilex L.	Y	Y	Y	Y	Y
	Quercus pubescens Willd.	Y	Y	Y	Y	Y
Geraniaceae	*Geranium robertianum L.*	N	N	N	Y	N
Guttiferae	*Hypericum perforatum L.*	N	N	N	Y	Y
Juglandaceae	*Juglans regia L.*	Y	Y	Y	Y	Y
Lamiaceae	*Calamintha nepeta (L.) Savi*	Y	Y	Y	Y	Y
	Melissa officinalis L.	Y	N	Y	Y	N
	Mentha longifolia (L.) Hudson	N	N	N	Y	Y
	Origanum vulgare L.	N	N	Y	Y	N
	Satureja montana L.	N	N	Y	Y	N
	Satureja montana L. subsp. montana	N	N	Y	Y	N
	Teucrium chamaedrys L.	Y	Y	Y	Y	N
	Thymus serpyllum L. S.L.	Y	N	Y	Y	Y
Liliaceae	*Asparagus acutifolius L.*	N	Y	Y	Y	N
	Sambucus nigra L.	Y	Y	Y	Y	Y
Moraceae	*Ficus carica L.*	Y	Y	Y	Y	Y
Oleaceae	*Fraxinus excelsior L.*	Y	Y	N	Y	N
	Fraxinus ornus L.	Y	Y	N	Y	Y
	Phillyrea latifolia L.	N	N	N	Y	N
Pinaceae	*Abies alba Miller*	N	N	Y	Y	N
	Pinus nigra Arnold	N	Y	N	Y	Y

Plantaginacae	*Plantago lanceolata L. S.L.*	N	N	N	Y	N
	Plantago major L.	Y	Y	N	Y	N
Polygonaceae	*Polygonum aviculare L. S.L.*	N	N	N	Y	N
	Ruscus aculeatus L.	N	Y	N	Y	Y
Primulaceae	*Cyclamen hederifolium Aiton*	Y	N	N	Y	N
	Cyclamen repandum S. et S.	Y	N	N	Y	Y
	Primula vulgaris Hudson	N	N	Y	Y	N
Ranunculaceae	*Clematis flamula L.*	N	Y	Y	Y	N
	Clematis vitalba L.	Y	Y	N	Y	Y
	Helleborus bocconei Ten.	Y	N	N	N	N
	Helleborus foetidus L.	Y	Y	N	Y	N
	Hepatica nobilis Miller	N	N	N	Y	N
	Ranunculus lanuginoso L.	N	N	N	Y	N
	Ranunculus repens L.	N	N	N	Y	N
Rosaceae	*Agrimonia eupatoria L.*	Y	N	N	Y	N
	Crataegus monogyna Jacq.	N	Y	Y	Y	N
	Fragaria vesca L.	N	N	N	Y	Y
	Malus domestica Borkh.	N	N	N	Y	N
	Potentilla reptans L.	N	N	N	Y	N
	Prunus avium L.	Y	Y	N	Y	N
	Prunus spinosa (L.)	N	N	Y	Y	N
	Rosa arvensis Hudson	N	N	Y	N	N
	Rosa canina L. S.L.	Y	N	Y	Y	Y
	Rubus hirtus W. et K.	N	N	Y	Y	N
	Rubus idaeus L.	N	N	N	Y	N
	Rumex scutatus L.	N	N	Y	N	N
	Sanicula europaea L.	N	N	Y	N	N
	Sorbus aria (L.) Crantz	N	Y	Y	N	N
	Sorbus domestica L.	Y	Y	N	Y	N
Rubiaceae	*Cruciata laevipes Opiz*	N	N	N	Y	N
	Rubia peregrina L.	Y	Y	N	Y	N
Salicaceae	*Populus nigra L.*	Y	N	N	N	N
Tiliaceae	*Tilia cordata L.*	N	N	N	Y	N
Ulmaceae	*Ulmus minor Miller*	Y	Y	Y	Y	Y
Urticaceae	*Osyris alba L.*	N	N	N	Y	N
	Parietaria diffusa M. et K.	N	Y	N	Y	N
	Parietaria officinalis L. S.L.	Y	Y	N	Y	Y
	Urtica dioica L.	Y	Y	Y	Y	Y
Verbenaceae	*Verbena officinalis L.*	N	N	N	Y	N
Violaceae	*Viola L. species*	N	N	Y	Y	Y
	Viola alba Besser	N	Y	Y	Y	Y
	Viola pyrenaica Ramond	N	N	Y	Y	Y
	Viola reichenbachiana Jordan	N	Y	Y	Y	Y
	Viola rupestris F. W. Schmidt	N	N	Y	Y	Y

Devotional icon of St. Michael the Archangel at the Shrine of St. Michael in Liscia, Abruzzi. Photo by Katia Marsh.

CHAPTER FIVE

General Discussion

In this thesis, I investigate the relation between spirituality and ecology at sacred sites in Central Italy, and examine their potential for biodiversity conservation and management. During the last decade, awareness has grown that the future of biodiversity will largely depend on the ability to conserve species and habitats outside of protected areas (Farina 2000; Rosenzweig 2003; Willis et al. 2012), and to redesign conservation schemes in ways that better integrate social as well as environmental values (Jepson and Canney 2003). Sacred natural sites (SNS) are habitat patches traditionally protected in virtue of their spiritual significance (Dudley et al. 2009). SNS clearly do not offer a blueprint solution to all conservation issues. They can provide, however, a significant contribution to *in situ* conservation (Bhagwat and Rutte 2006; Dudely et al. 2010), and demonstrate the importance of intangible non-utilitarian values as motives of biodiversity preservation (Byers et al. 2001; McCauley 2006).

This is the first study of its kind to scrutinize the occurrence and conservation potential of SNS in a western context, relying on a systematic approach and quantitative as well as qualitative evidence. My main goal was to investigate whether it is possible to find important traces of a connection between natural elements and spiritual beliefs also in non-traditional and largely secularized societies, and if those instances can contribute to conservation goals.

Distribution and patterns of sacred sites

Even though Christianity is commonly seen as anti-naturalistic, or at least somehow indifferent towards the world of nature (White 1967; Passmore 1974), I found that Catholic sacred sites are frequently associated with natural habitats (*Chapter 2*): of 539 sacred sites I inventoried, ca. one-third were located in forests, woodlands, or mountainous settings, and an additional 25% ca. in agricultural landscapes, while the remainder was found in urban or periurban contexts. This association might have originally had pragmatic reasons (for example, because forests and remoteness guaranteed peace and isolation to religious communities), rather than being directly related to a sanctification of nature. However, I also found that natural features were explicit targets of devotion at least at thirty out of one hundred sample sites which I visited during fieldwork reconnaissance. Such a figure is essentially in line with earlier findings by Nolan and Nolan (1989).

Another significant insight was that associations of religious sites with natural habitats are common for certain strands of Roman Catholicism, but nearly absent for others. Specifically, the occurrence of SNS seems strongly related to folk spiritualities, where local beliefs are integrated into a Christian framework (De Waal 2012), and to monastic traditions inspired by ideals of asceticism and austerity (Leyser 1984). These findings confirm the importance of folk beliefs and religious syncretism in the maintenance of SNS (Byrne 2010; Verschuuren et al. 2010). However, they also point at the prominence of natural settings for certain institutional communities of Roman Catholicism (e.g., Franciscans, Camaldolese), and at the heterogeneity of relations with the environment within western Christianity (see also Binde 2001). This is a theme that should be developed more thoroughly in the theological study of Christianity and ecology.

Floristic patterns and conservation values of SNS

Quantitative analyses of habitats and vegetation at thirty natural shrines, and comparison with an equal number of control sites (*Chapters 3* and *4*), confirmed what had already been foreshadowed in *Chapter 2* on the grounds of qualitative appraisals: that also in Central Italy, SNS display prominent environmental traits, and have conserved habitat patches of high ecological value. Indeed sacred sites harbored a significantly higher number of plant species than control sites, although the differences were not exceedingly marked (*Chapter 3*). A clearer influence was detected in relation to forest structure: patches of old-growth forests had been conserved at sacred sites (*Chapter 3*), and there was also a significant pattern in the spatial distribution of trees, as the largest specimens occurred in close proximity to shrines or sacred buildings (*Chapter 4*). These findings are surprisingly similar to those from a radically different geographic and cultural context, such as Tibet. Researchers found that also Tibetan SNS are associated with species-rich habitats and have conserved giant trees, although they do not host a significantly higher number of plant species than control sites (Anderson et al. 2005; Salick et al. 2007).

The thirty SNS I surveyed differed from the control sites also with regards to useful plant diversity, which was significantly higher (*Chapter 4*). Those differences, however, quite linearly reflected overall diversity patterns, and did not support the hypothesis that sacred sites have been conserved as repositories of useful plants. Indeed the proportion of useful species out of total species richness was even slightly lower at sacred than control sites, although in this case there was not statistical significance. This pattern contradicts initial hypotheses, and contrasts with findings from other parts of the world, where SNS have been found to be used as living repositories of ethnobotanical resources (e.g., Boraiah et al. 2003).

Three possible explanations could be advanced to interpret this result. The first one is that the management of ethnoflora at the sacred sites in question has never been seen as convenient, for example due to the remoteness of the latter. Although they are related to specific villages or rural communities, in effect, most of the sites in my sample are located in isolated settings, usually at higher elevations or at significant distances from human settlements. Further, in many cases they are visited by community members only once or few times a year, in occasion of specific devotional festivities. Proximity to and accessibility of collection sites, on the contrary, is one of the most important criteria in the selection and occurrence of ethnobotanical resources (Weckerle et al. 2006). A second hypothesis could be that sacred sites were over-harvested for useful plants, presumably following the relaxation of customary norms, and consequent governance failure. A similar explanation should not be excluded, as it is in line with what is being currently witnessed at sacred sites in other parts of the world, under the pressure of development forces and societal change (Ormsby and Bhagwat 2011). A third interpretation, finally, could be that sacred sites in Central Italy have lost their function of repositories of natural resources over the last fifty years, after the depopulation of rural areas (Blondel et al. 2010), and the waning of many religious traditions related to nature (Micati 2007; Antinori 2009). During this time of interrupted management, sacred sites might have reverted to surrounding vegetation, and lost part of their floristic distinctiveness.

Another question that can spontaneously arise in relation to sacred places, but is seldom addressed in the literature, concerns the causal relationship between place sanctity and biodiversity (Salick et al. 2007). In plain words: are SNS biologically diverse because sacred, or are they sacred because biologically diverse? This corresponds, after all, to casting in new ecological terms a question about that has haunted geographers and religion scholars for a long time, concerning the creation (or emergence) of sacred space (Knott 2005). My results would seem compatible with both interpretations. On the one hand, I found that SNS are often associated with outstanding landscape emergences and unique combinations of habitat features, such as the joint occurrence of forest, caves, and water sources: this complexity in habitat composition also constitutes one of the main differences between sacred and control sites. On the other hand, my data also suggest that micro-habitat heterogeneity, which was positively correlated with species richness, has been maintained by low-intensity forms of human management. This is consistent with the intermediate disturbance hypothesis in ecology (Pausas and Austin 2001), and would rather support the idea that biodiversity patterns at SNS are dependent on anthropogenic activity. The two hypotheses, of course, are not mutually exclusive, and might apply differently to each specific case.

Significance and limitations of the study, and prospects for future research

My results successfully showed that place-bound examples of an intimate connection between spirituality and nature are widespread, also in contexts that are commonly thought of as intrinsically "modern" or secularized. These are findings of great relevance, as they support the idea of SNS and nature-related forms of spirituality as universal, trans-cultural phenomena – and in this sense, the analogies found between SNS in such dramatically different contexts as Central Italy and Tibet are particularly significant. Also, the results confirm the tight relation between intangible and spiritual values, and the origins of a conservation *ethos* (Ramakrishnan 2003).

Besides the acquisition of these important insights, the picture of SNS offered by this study remains inevitably incomplete, being mainly limited to ecological valuations. Specifically, I can identify three critical areas in which the scope of the work had to be narrowed down, and that would represent desirable avenues for future research: (1) definition of the study system, and selection of sample sites; (2) lack of a historical dimension; and (3) lack of ethnographic data. Similar lacunae currently hinder the possibility to translate the results into fully informed management advices. I will briefly elaborate on each point.

Definition of the study system and selection of sample sites

To simplify and make manageable an extremely diverse system, some limiting choices had to be made. In the first place, from the environmental point of view, I focused exclusively on sacred sites located in "natural" settings (that is, dominated by forested land or mountainous grasslands). I did not include, instead, sites in agricultural and semi-natural landscapes, although those might also support small patches of woodland and natural habitats, or be associated with devotions for natural features. Also, given the unavailability of some geo-reference data, I left out spatially explicit approaches, although these could have been pertinent in several ways. These could have included, for example, an analysis of the spatial distribution of sacred sites with relation to altitudinal gradients, official protected areas, areas of high floristic value, and other biodiversity databases. A similar take could have been desirable to obtain synthetic information on the ecological value of a greater number of sites.

A second selection was made with regards to the type of sacred places sampled and surveyed. Indeed, I conducted vegetation assessments only at shrines and pilgrimage sites, leaving aside monasteries and other sites where formal religious communities reside. This was necessary because, as explained in *Chapter 2*, the two categories of site greatly differ: their ecological study would require different methods and, to a certain extent, different research questions. As I showed, however, the monasteries of certain communities are also frequently associated with natural settings, and reveal important ecological values. The ecological study of monastic estates and surroundings would considerably add to our understanding of sacred sites, and to the study of the environment in different strands of Christianity.

Historicity and sacred sites

My study offers a synchronic snapshot of the traits of some SNS. Elements like environmental conservation of the sites, and a relation between nature and spiritual beliefs, are taken for granted, as if they were timeless and wholly consensual entities beyond historical change and social conflict. Yet, changes are continuous throughout history, and social conflicts are often powerful drivers. An important historical trend, for example, seems captured by some of my data, as mentioned in *Chapter 2*: the declining importance of natural settings for Catholic sites after the Middle Ages. This process seemingly went hand in hand with the substitution of manufactured heritage (chapels, icons) for earlier natural features (*Chapter 2*). Similar trends are currently reported in other parts of the world with reference to sacred sites – for example in India, where they go by the label of "Sanskritisation" (Kalam 1996) – and coincide with the abandonment of earlier nature-related worships.

A historically sensitive approach would carefully examine these trends throughout time, and aim to identify their causes. The loss of importance of natural sites in the Catholic tradition, if confirmed, could be the reflection of larger socio-cultural mutations, such as the rise of an urban society and later of a scientific culture (Carter 2003). But space and religion frequently are also arenas for the exercise of power and the redefinition of political balances (Scott 1998; Huxley 2007; Verschuuren et al. 2010). Sacred places themselves can be "contested space" (Chidester and Linenthal 1995), embedded in this wrestle between conflicting forces, and as such, the changing spatial distribution of sacred places could be fruitfully interpreted through the theoretical lenses of political ecology (Greenberg and Park 1994). This would be an important addition, in order to put the idea of conservation at sacred sites in a perspective of historical dynamism, and gain insight into processes, which are currently underway in other cultural contexts, often leading to severe environmental consequences.

Ethnography and the social dimension

In this study, I largely dealt with cultural values of biodiversity, and the human dimension of conservation. I did so, however, mostly on the basis of ecological data and secondary sources: direct engagement with local populations is not part of the research presented here. The lack of ethnographic approaches or face-to-face interviews has been a major limitation in the study of SNS up to date, although there are encouraging signs of a change of trend (e.g., Ormsby 2011). The findings of this work should be ideally complemented by social science data, aimed to comprehend the perspective of local people. Topical areas to be targeted through interviews and participant observation should include: current perception of utilitarian and intangible values of SNS; specific importance of natural heritage for the spiritual experience of SNS, and the religious celebrations there performed; management arrangements, and related difficulties and shortcomings; and (when relevant) relation with state-driven protected areas and official conservation schemes. Assessing these points would be especially important for gaining a sharper picture of the values of biodiversity in contemporary social contexts, and in the perspective of enhancing the conservation synergy between SNS and official protected areas: the elaboration of management advices informed by the findings of the present study, should first pass through a stage of confrontation and interaction with the local stakeholders.

Conclusions

In this thesis, I use a transdisciplinary approach to demonstrate the importance of sacred natural sites in Central Italy. I show that associations between sacred sites and natural landscapes are especially frequent for certain strands of Catholicism. Further, the sites in question display high biodiversity values, which highlight their prominent role for conservation. These results are in line with findings on sacred natural sites in very different cultural and geographical settings around the world, but their empirical and quantitative testing constitutes a significant novelty in a western post-industrial setting. Better examination of local cultural contexts would be needed, to assess how these sacred sites could enhance conservation schemes, and be managed most successfully for the benefit of both nature and people.

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